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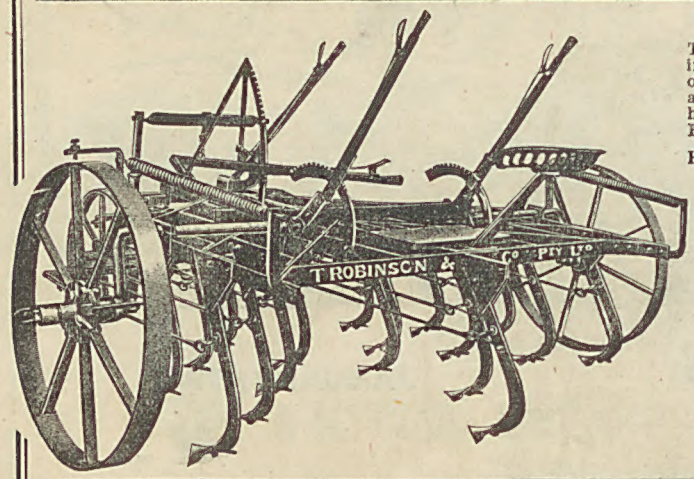

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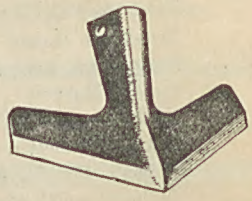

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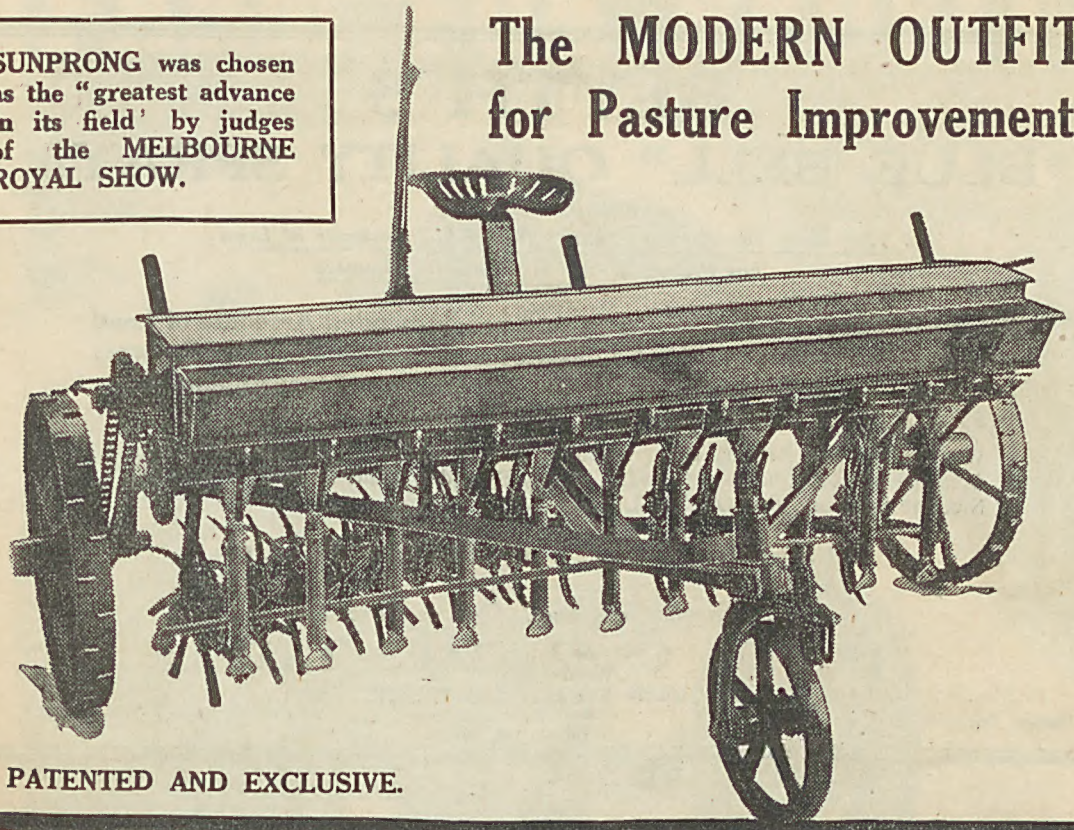

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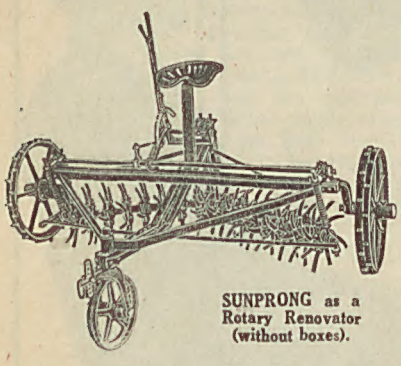

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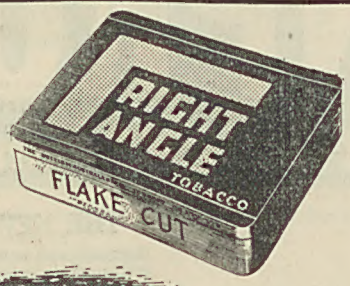

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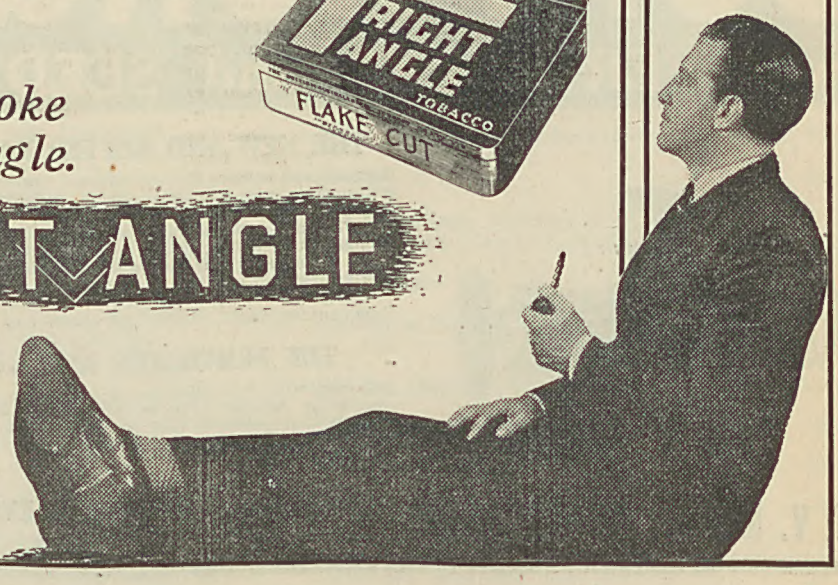

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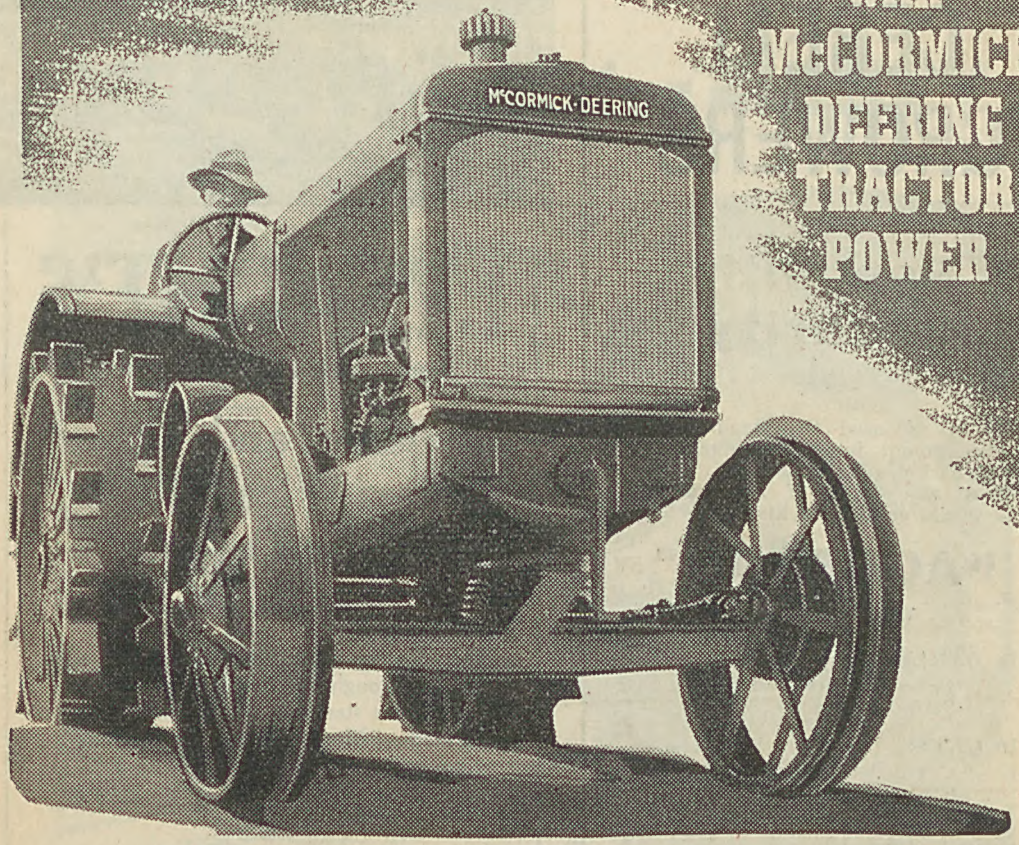

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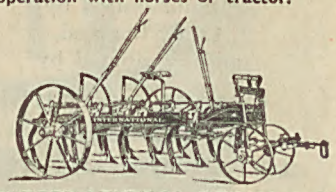

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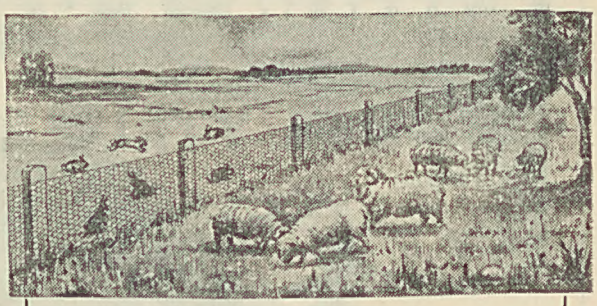

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Pedigree or Production Records?

Need for Advanced Registers

By W. J. Yuill, Supervisor of Herd Testing

DESPITE the many disappointments experienced by some breeders in the pursuit of their ideal, be it production or type, or both, some do consistently secure a high degree of success in their breeding work. Almost invariably it will be found that success has come from selecting with great discrimination, those animals which have been proved to possess a high degree of purity in the characters being developed.

Some prominent breeders have developed herds which have gained many successes both in the show ring and at the pail.

To have successfully developed a high producing herd from the heterogeneous mass of material of which the various breeds are composed, stamps a breeder as having unusual ability, for many have lightly undertaken the task with very unhappy results.

That there is dissatisfaction concerning the low level of production of the various pure breeds of cattle is evident from many sources. Investigators in various parts of the world apparently agree that something must be done or, as one authority puts it, the purebred will lose some of its old-time lustre.

The system of herd-book registration has been blamed by some who claim that registering dairy animals on ancestry qualifications only is the greatest drag to breed improvement, since the bad are registered on an equal footing with the good, and they are registered in ever increasing numbers.

In February, 1935, the permanent Committee of the International Institute of Agriculture—after consulting with various Government Experts—held a conference at Rome at which a draft convention was drawn up for submission to a Diplomatic Conference. With regard to milk recording work it was suggested that efforts be directed to securing uniformity throughout the world so that yields might be rationally compared. The finding of the Committee runs as follows:—"That the recording of yields shall be organized

Mr. N. H. Enders' "The Wattles Princess 4th"—First in Type and Utility (Jerseys) 448 lb. butter-fat (R.A.S., 1937).

by Herd Book Societies, or by other special institutions working in full agreement with them : and in accordance with principles and methods which shall be as uniform as possible. In each case the information to be given on the individual sheets must indicate, in addition to the milk and butter-fat yield, the frequency of the tester's visits, the length of the recording beginning from the 6th day after calving, and the date of the first calving which followed the last recording period.

The standardization of Herd Books has also received considerable attention ; among other findings are the following :—

No. 3. All Herd Books shall be arranged on identical lines and shall contain—

A. Register of Births ;

B. Register of Males whose eligibility has been approved after inspection ;

C. Register of Females on same lines.

No. 4. No certificate to be issued for any animal over registration age, except those mentioned in "B" and "C."

No. 5. Besides the three registers in article 3, which should be compulsory, it is recommended to authorities in charge of Herd Books, that there shall be

Friesian Type and Utility Winners Melbourne Royal Show, 1937—From left, "Victoria Quilt," 553 lb.; "Victoria Ilkabelle" 384 lb.; "Elgin Glen Ashlynn", 526 lb. and "Victoria Chorus Girl" 652 lb. butter fat.

Winners of the Type and Utility Section (Jerseys) at last year's Melbourne Royal.

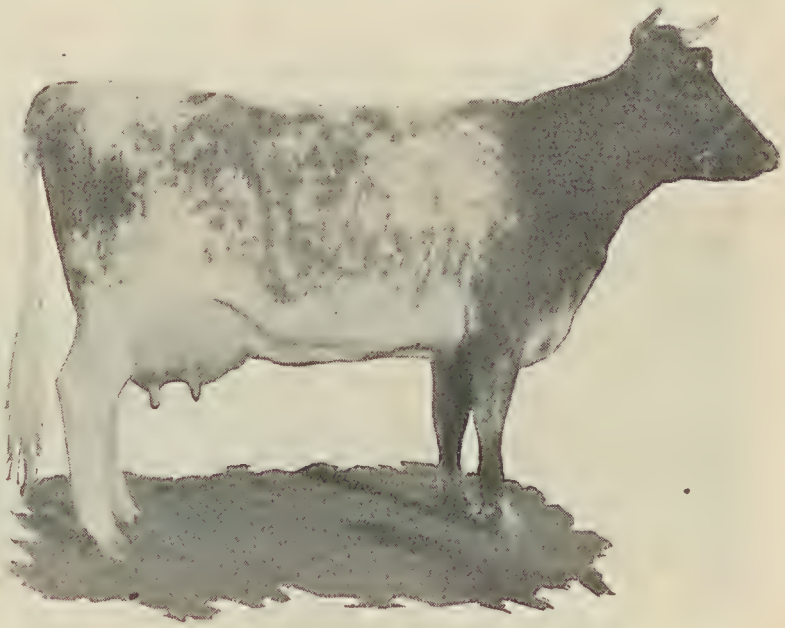
established an *Advanced Register, or Register of Merit*, in which shall be entered those animals whose officially recorded yields in competitions, as well as in the sheds at home, have reached a previously determined standard. As far as sires are concerned the entry into the Advanced Register shall be made on the basis of the yields of at least four of their daughters.

No. 6. That the regulations for initial entry shall become more severe and rigorous year by year.

No. 7. That in open as well as in closed herd books, the final entry of an animal — *although eligible on ancestry* —cannot be accepted unless *proved eligible on inpection.*

No. 8. *For all types of animals whose performances can be measured, testing shall be organized by the Herd Book Association;* or by some institution working in full agreement with them. The results of the testing or performance must be shown on the individual sheet of each animal, and also on any certificate, or copy of the individual sheet issued by the herd book organization.

This then is the recommendation of a world court, after many years of committees, conferences and congresses which were held in various countries. In some quarters the present system of judging dairy cows is being attacked, for



Mr. W. K. Atkinson's "Willow Park Moss Rose 9th"—First in Type and Utility (Dairy Shorthorns) 1937.

agricultural and breed societies have been slow to move in the matter of "measuring the performance of dairy cattle" rather than merely inspecting their conformation.

The oldest stud-book in the world is that of the blood horse, and it still is largely a performance register, for if a stallion can make fast performances, his services are in demand; if his progeny fail to prove him to be a performer and a *begetter of performers* his demand quickly falls away and his place is taken by another outstanding performer—the progeny proof being the accepted proof of his greatness.

The draught horse must have its ability measured by the dynamometer, the hunter and jumper must make the height, the trotters must make the time; even the sheep dog trial is one of performance, as are also the tests for the noisy whippets—all are tests of ability. With beef animals, swine and sheep, a reasonably true measure of their quality and conformation can be judged. This is not true of the dairy cow for her performance can be measured only over one or more normal lactations. Further, this character is not exhibited in the male animals of the breed; the necessary evidence can only be had from the production records of his daughters — the supposed milkiness of character of a bull is a myth, for a bull is built on opposite lines to a dairy cow. He is massive in front where she is fine, and he is light at the rear where she is well developed.

Non-testing owners are often keen exhibitors at Agricultural Shows, for the unknown productive ability of their stock is not advertised in this way. Several months of shedding and preparatory feeding, grooming and blanketing, can work wonders for an "appearance test" which usually lasts for less than one hour and rarely longer than one day. To the unsophisticated, the show time bloom of a few selected animals is a representation of the owner's herd, and of a large number of individuals of the breed. A much truer opinion of the mass can be obtained only by visiting a number of stud farms during the "off show" period. No wonder that Professor Boutflour, Principal of the Royal Agricultural College, England, says, *inter alia*, that, to-day in this country we have :—

(*a*) No successful breeders of dairy stock.
(*b*) Judgment of dairy cattle by appearance and a fetish for type.
(*c*) Insincere standards of judging at shows.
(*d*) Almost complete ignorance of scientific breeding.
(*e*) A belief that beef represents constitution.
(*f*) An inheritance of a lot of poor milking cows both registered and unregistered.
(*g*) The science of genetics.

Some breeders may disagree with Professor Boutflour on one or more of his points; but he surely is on sound ground when he asks whether the British Friesian cow, Hedges Rose, was not a champion dairy cow, seeing that she averaged nearly 100 lb. of 4 per cent. milk in the milking trials at five consecutive Royal Shows, and averaged about 20,000 lb. of milk in each year, and yet was ignored by the judges.

Woodlands Felicie the great New Zealand Jersey cow, who held the world's butter-fat record; Abigail of Hillside champion Jersey producer of America, and Babs of Somerville, one time four-year-old champion of the British Empire, are other instances of great producing cows which failed to please the breed judges. It might be that the tail setting is a little high,

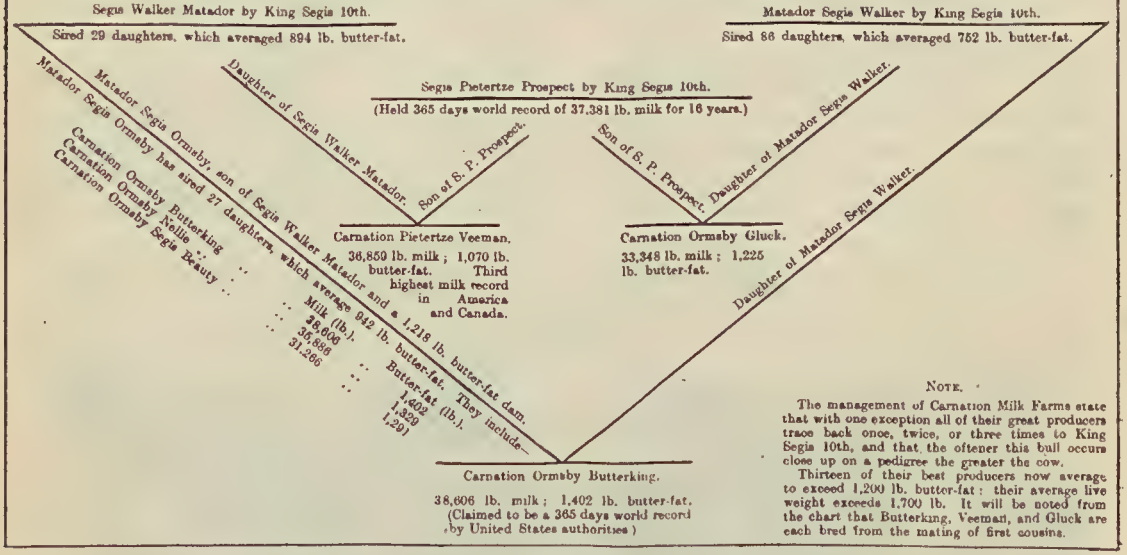
Ayrshire Type and Utility winners, Royal Show, 1937. From left—"Donside Lydo Lady," 672 lb; "Bonnie Doon Beth," 452 lb., as a Junior two-year-old; "Inverurie Heather," 420 lb.; "Bonnie Doon Snowdrop," 555 lb.; "Bonnie Doon Heather," 625 lb. and "Donside Thistledown 2nd," 488 lb. butter fat.

or the thurls a little low; or the top line fails to make a graceful sweep from the poll to the tail-head; or maybe the udder protrudes too far below the belly line, or the set of the udder is not just right. Such cows are not likely to pass the aesthetic standards of some breed judges. At least Professor Boutflour is right when he says that there is need for a sincere standard by which dairy cows may be judged, and that there is a fetish for mere physical attainment; further, that there is need for greater knowledge of the principles of breeding, and that there are large numbers of inherently poor milking cows among pedigree and non-pedigree animals alike.

It is not too much to claim that there is very little real progress being made by any of the breeds, and that the present imperfect system of registration can never effect any improvement so far as the purely dairy character is concerned, for all animals are registered solely on the basis of the previous registration of both parents. No qualifications are sought regarding the dairy character in the parents, and no evidence of it is sought in the animal to be registered; therefore, the mass of registered animals goes on increasing, the good and bad alike, for there is no discrimination. Surely if the whole issue of the registered parents may be registered, the time has come for an advanced register as suggested by the International Institute of Agriculture, viz.:—on the basis of *inspection and production*.

Some authorities affirm that there are but a few animals alive at any one time which add anything to the high level of any breed. Such an animal was King Segis 10th an American born son of a Holland bred Friesian cow. That he was practically as homozygous in the purely dairy character, as he was in his breed character, may be gauged from the short pedigree and story of three of his most famous progeny, which is shown in the accompanying chart. When his daughter Segis Pietertze Prospect made a world record of 37,381 lb. milk in 1920, she was termed a freak cow, and it was considered unlikely that such a record would ever be surpassed. The history of this cow and her two equally famous half-brothers, however, is told in the story of Carnation Milk Farm where several hundred registered Friesians

CHART OF KING SEGIS 10TH, A PURE BRED FRIESAN BULL, WHO WAS ALSO HOMOZYGOUS IN THE DAIRY CHARACTER. THIS IS SHOWN IN THE FOLLOWING STORY (SEGIS PIETERTZE PROSPECT, SEGIS WALKER MATADOR, AND MATADOR SEGIS WALKER ARE ALL PROGENY OF THIS WORLD-FAMED SIRE) :—


Segis Walker Matador by King Segis 10th.
Sired 29 daughters, which averaged 894 lb. butter-fat.
Matador Segis Walker by King Segis 10th.
Sired 86 daughters, which averaged 752 lb. butter-fat.
Segis Pietertze Prospect by King Segis 10th.
(Held 365 days world record of 37,381 lb. milk for 16 years.)
Daughter of Segis Walker Matador.
Son of S. P. Prospect.
Son of S. P. Prospect.
Daughter of Matador Segis Walker.
Matador Segis Ormsby, son of Segis Walker Matador and a 1,218 lb. butter-fat dam.
Matador Segis Ormsby has sired 27 daughters, which average 942 lb. butter-fat.
Carnation Ormsby Butterking
Carnation Ormsby Nellie
Carnation Ormsby Segis Beauty
Milk (lb.).
38,606
35,856
31,266
Butter-fat (lb.).
1,402
1,329
1,291
They include—
Daughter of Matador Segis Walker.
Carnation Pietertze Veeman.
36,859 lb. milk; 1,070 lb. butter-fat. Third highest milk record in America and Canada.
Carnation Ormsby Gluck.
33,348 lb. milk; 1,225 lb. butter-fat.
Carnation Ormsby Butterking.
38,606 lb. milk; 1,402 lb. butter-fat.
(Claimed to be a 365 days world record by United States authorities.)

NOTE.

The management of Carnation Milk Farms state that with one exception all of their great producers trace back once, twice, or three times to King Segis 10th, and that the oftener this bull occurs close up on a pedigree the greater the cow.

Thirteen of their best producers now average to exceed 1,200 lb. butter-fat: their average live weight exceeds 1,700 lb. It will be noted from the chart that Butterking, Veeman, and Gluck are each bred from the mating of first cousins.

OFFICIAL WORLD HERD TEST RECORDS (365 DAYS).

Country.	Breed.	Name of Cow.	Milk (lb.).	Butter-fat (lb.).
Japan	Friesian	Ellen Pietertze Granson	41,112	1,793
"	"	Frins Anna Roland	37,923	1,827
Australia	Milking Shorthorn	Melba 15 of Darbalara	32,522	1,614
United States of America	Friesian	Carnation Ormsby Butterking	38,606	1,402

are milked. The management state that of 300 lines of breeding which have been tried, they have discovered that a super-producer can be assured whenever the breeding of three certain lines occur close up in a pedigree. Matador Segis Ormsby was selected in 1926 because he had these lines of breeding close up in his pedigree. His success as a herd sire has been truly wonderful. To date his 27 daughters with year records have the remarkable average of 946 lb. butter-fat, while his sire's 29 daughters have an average of 894 lb. for a similar period. A study of the data referred to will show that Matador Segis Walker the most extensively proven son of King Segis 10th has 86 daughters which have averaged 750 lb. butter-fat, while a son of old Segis Pietertze Prospect has six tested daughters which have exceeded 30,000 lb. of milk. When a son and daughter of the two celebrated full brothers were mated, they produced the present "high" milk and butter-fat cow, while the family also produced four of the highest milk yielders in Canada and America. It can safely be inferred that all of these performances have been made under record-breaking conditions. However, only those men who have developed a 700 lb. butter-fat cow can truly appreciate the magnitude of the effort required to double the yield. The great success of these selected animals is an indication of the high levels of the breed.

To come nearer home, the history of the famous New Zealand cow Burkeyje Sylvia Posch and her equally famous daughter Rosevale B. S. Posch, are but further examples of the marvellous milking capacity of selected animals and families. The first-named cow produced 5,086 lb. butter-fat in seven lactations, while her daughter produced 5,121 lb., in a similar period. Five daughters of the old cow have 22 records which average 642 lb. butter-fat, while five sons have 94 tested daughters in New Zealand, whose 140 records average 598 lb.

Not many cows have lifetime test records which exceed 5,000 lb. butter-fat; several of the Victorian "long distance" cows have earned this distinction including Miss Guy of Tarnpirr, 11 years, 5,874 lb., Cherry 5th of Willow Park, 10 years, 5,990 lb., Fairy of Willow Park, 9 years, 5,481 lb., Blush of Willow Park, 12 years, 5,388 lb., and Bunty 2nd of Coliban, 10 years, 5,190 lb., while Narcissus of Springhurst produced 4,986 lb. in 9 years. All of these cows have produced above these figures in the number of lactations stated, for the standard test period is one of 273 days; whereas in other countries it is usually 305 or 365 days. The world's record is said to be that of 8,240 lb. produced in 9 years by a Canadian Friesian cow, Springbank Snow Countess. Sophie 19th of Hood Farm, and her daughter—two American jersey cows—each exceeded 7,000; as did also the Guernsey cow Brilliant Lassie.

Efforts are being made to establish long distance clubs in some countries and credit is due to the Ayrshire Society of America for its establishment of the 100,000 lb. milk club.

Quite a number of Victorian Standard Test cows have this qualification, particularly within the large breeds. Many Friesian cows produce this amount in five years, indeed, there are upwards of 1,400 cows with such records in England, New Zealand, Canada, and the United States of America. Of all the breeds, the Friesian

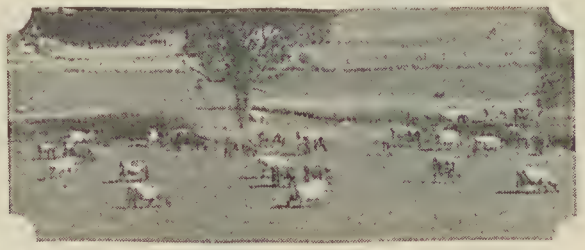
Left, "Yarraview Ella," Champion Guernsey cow and First in milk and butter fat test; Right, "Clara's Fashion 7th," (imp.) Reserve Champion, First in Type and Utility Section, (Guernseys) and Second in the open class. Both cows are owned by Capt. A. E. T. Payne.

Red Poll Type and Utility winners, Royal Show, 1937. From left, "Victoria Maid Marion," 316 lb. butter fat, 1st as Junior two-year-old; "Nundi Lulu," 380 lb., 2nd mature class and "Victoria Volt," 515 lb., 1st mature class.

cow can least claim to possess physical beauty and perfection of udder, yet no breed can successfully compete with it in the milk production character.

An outstanding need of the dairy industry to-day is a relatively high degree of purity in the production character of the selected registered animals, for it is to these animals that the dairy industry looks for herd sires to develop the commercial herds. If a breed or individual fails in this respect, it fails as far as the dairy industry is concerned, for the dairy farmer depends for his living on the sales of dairy produce. When he is purchasing a new herd sire, he is like unto a man taking a train journey, he cares little about where his train came from, so long as he knows where it is going; so the farmer is worrying more about the ability of a sire's daughters to produce economically than he is about the array of names in a pedigree which usually mean very little to him. More selection is badly needed in all breeds; for this purpose more extensive testing is essential if the best that the breeds possess is to be known and fully developed. The slavish worship of mere appearance doubtless will persist until the cost be not worth the worship, for the dairy farmers are awakening to the need of a bull relatively pure for high yield, plus the characteristics of the breed which they may prefer.

A review of the past 25 years of the Standard Herd Test would suggest that a great number of breeders entered their herds in high hopes, and withdrew them because of their unsatisfactory showing. Quite a variety of excuses have been offered, including that of cost, yet these herds are rarely entered in the equally effective, but cheaper District Herd Testing System.



A fruit packing class at work—Somerville.

Fruit Packing Charts

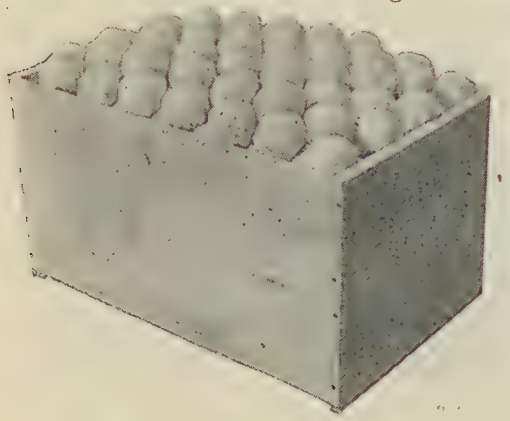
For Yates Apples and Josephine Pears

By Basil P. Krone, Fruit Packing Instructor

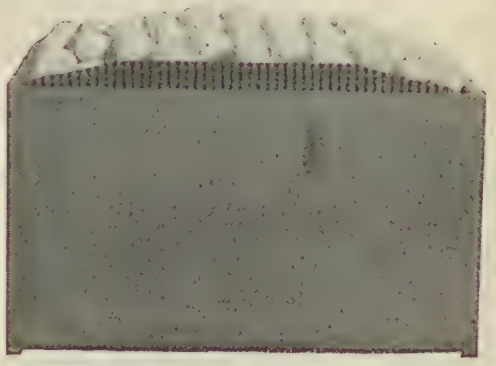
THE Yates is a smaller apple than most other varieties that are sent overseas; the Josephine likewise differs from other varieties of pears; for this reason, special charts and diagrams relating to their packing have been prepared.

Packing the Yates.

The 4—3, the 3—3, and the 3—2 packs, with the "straight" method of diagonal packing, are recommended. An example of each of these packs is illustrated in the diagrams. The



A case of 2⅛ in. Yates apples packed 4-3.



Correct use of side cardboards protects the bulge. If cardboards are of insufficient width, do not place in case until the bottom ayer is packed.

apples should rest upon their cheeks; they should be equal distances apart and all (except the final apples in each layer) have their stalks turned away from the packer, and the rows must run diagonally across the case.

With this system the packer, quite unconsciously perhaps, will form large pockets between the fruit. These spaces will greatly lessen the chances of bruising—one of the troubles that must always be guarded against when packing fruit for export. If properly

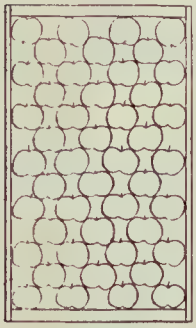
The first thing to master in packing is the correct manner of placing each apple in the first layer. A strict observance of the method for bringing the fruit to the necessary height in the case is also essential if cases are to open up well at the other side of the world.

Special Chart for Packing Yates Apples in the Canadian Case.

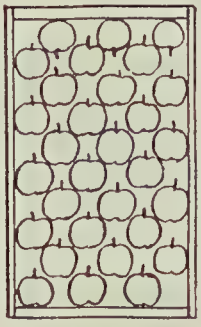
18 x 11½ x 10½ inches, inside measurements.

(Packing to counts and not to sizes eliminates underweight cases in the export trade.)

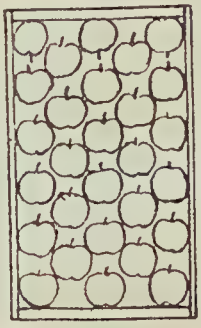
The "straight" method of diagonal packing.



4-3 Pack.



3-3 Pack.



3-2 Pack.

To obtain correct counts; avoid damaged fruit and underweight cases.—Apples should be reasonably uniform in size and packed in accordance with the Rule shown below. To do this successfully, it will be necessary to forget the established custom of sizing in gradations of equal quarter inches. *Some counts are between these sizes.*

Size.	Pack.	Layer.	Layers.	Total.	Remarks.
2⅛	4–3	7 x 7	7	343	The smallest possible 2⅛-in. apple. This count is suitable for the "crown" pack
	4–3	7 x 6	7	319	Commence the usual "bulge" packing with this count
	3–3	8 x 8	6	288	This count includes large 2⅛-in. and small 2¼-in. It is therefore between the sizes
2¼	3–3	8 x 7	6	270	
	3–3	7 x 7	6	252	
	3–3	7 x 6	6	234	
	3–3	6 x 6	6	216	This count includes large 2¼-in. and small 2⅜-in. It is therefore between the sizes
2⅜	3–3	6 x 5	6	198	
	3–3	5 x 5	6	180	
2¾	3–2	7 x 6	5	163	The smallest possible 2¾-in. apple
	3–2	6 x 6	5	150	
	3–2	6 x 5	5	138	
3	3–2	5 x 5	5	125	The smallest possible 3-in. apple
	3–2	5 x 4	5	113	

The correct height cannot be obtained unless the packer regulates the tightness of the pack in accordance with the size of the apples for a given style of pack. The following rule therefore should be observed:—The smallest apples intended for the 3–3 and 3–2 packs should be packed a little more tightly than usual, while the largest apples intended for these packs should be packed more loosely than usual.

Loading apples and pears—Victoria Dock, Melbourne.

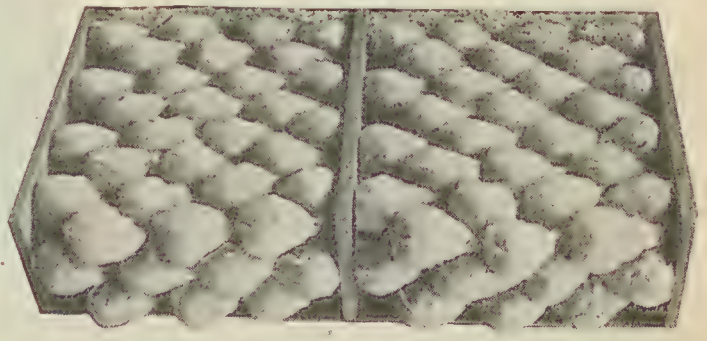
carried out, this method will provide a suitably sized pocket for each apple, with gentle pressure all round when a *suitable* lid of correct flexibility is nailed over a *suitable* bulge or crown.

Great care is required with the first layer; if packed too tightly it is liable to slip sideways. The top layer should be brought above the top of the case in an even bulge. The highest portion of the bulge should be uniform across the centre and should be from 1½ to 2 inches, or even more, above the top of the case, depending upon the size of the fruit, its firmness, and the pocket formation. The apples at each end should not project more than 1 inch, or even ¾ inch, above the top of the case.

The making of a bulge in the centre of the finished case is not difficult. The normal spaces between the fruit at each end help to a certain extent, and when apples of less diameter than 2½ inches are packed, all the operator has to do is press them down gently at the end of each layer, but not in the centre. Sometimes the fruit is loosened a little at each end of the bottom layer. This is done by tightening the pack more in the centre than at the ends, and so permitting the apples at the ends to rest a little more deeply than any of the others. With apples of a greater diameter than 2½ inches, it is an additional advantage to select unnoticeably smaller ones for the ends of each layer after the bottom one has been packed.

While the height to which the bulge should be brought above the case cannot be definitely fixed, it certainly should not be so high that the cheeks of the apples will protrude over the sides with consequent bruising when the lid is being nailed down.

Of course, it may happen when small apples are being packed that the cheeks in the top layer will be brought slightly higher than the top of the case. If this be so, the use of corrugated cardboard around the sides of the case



Pears packed for export in the "long" bushel case.

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is recommended. Corrugated cardboard is also recommended for top and bottom of the case. When cardboard is used at the sides it must project above the top, therefore it should not be placed in the case until the bottom layer has been packed.

Special Packing Chart for Josephine Pears in the Long Bushel Case.

(26 x 6 x 14¼ inches, inside measurements, clear of the division.)

This chart is recommended when Josephine pears are being packed for export in th Australian Long Bushel Case.

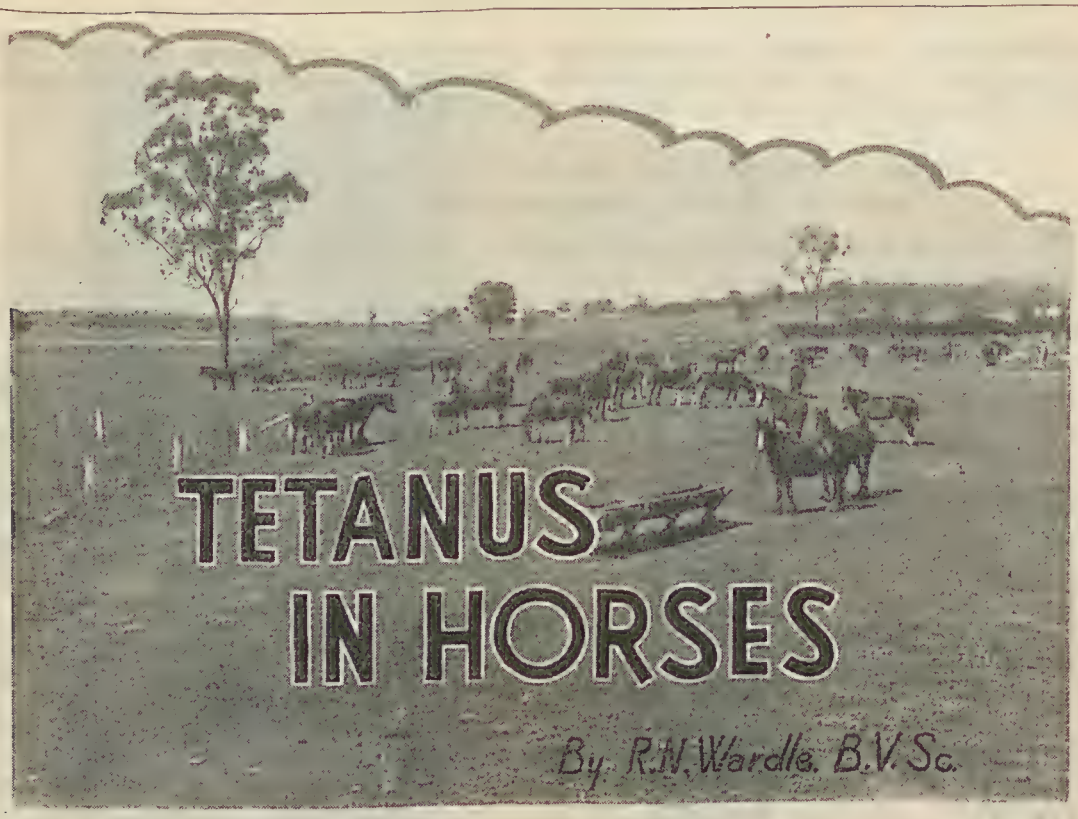
A complete observance of the methods of packing shown in the diagram is essential for satisfactory results.

2-1 Pack usual method. *2-1 Pack 126 count.* *2-1 Pack 106 count.* *1-1 Pack 96 count.*

Showing the method of placing Josephine pears in the bottom layer of the Long Bushel Case for the 2-1 and 1-1 packs. For the 126, 106 and 96 counts the stalks face sideways.

Size.	Pack.	Layer.	Layers.	Total.	Remarks.
2⅛	2–1	5 x 5	8	240	
2¼	2–1	5 x 4	8	216	
2⅜	2–1	4 x 4	8	192	Pack a little more loosely than usual
2½	2–1	4 x 3	8	168	Pack a little more loosely than usual
2⅝	2–1	3 x 3	8	144	Pack a little more loosely than usual
2¾	2–1	3 x 3	7	126	Stalks face sideways
2⅞	2–1	3 x 2	7	106	Stalks face sideways
3	2–1	3 x 2	6	90	Normal pack
3⅛	1–1	4 x 4	6	96	Stalks face sideways
3¼	1–1	4 x 3	6	84	Stalks face sideways

15529.—3



TETANUS IN HORSES

By R.N. Wardle, B.V.Sc.

TETANUS, more popularly known as "lockjaw," is a disease of the nervous system affecting most animals and man. Among the domesticated animals, horses and sheep are most susceptible, and cases occasionally are seen in swine. Cattle and dogs, however, possess a marked natural resistance to the disease. Tetanus is an example of an infectious disease which is not contagious, i.e., spread from animal to animal by contact, and is caused by the *Bacillus tetani*. These micro-organisms elaborate a very powerful toxin or poison during their growth and multiplication, and the symptoms which characterise tetanus are caused, not by the invasion of the body by the germs, but by the absorption of this poison from infected wounds.

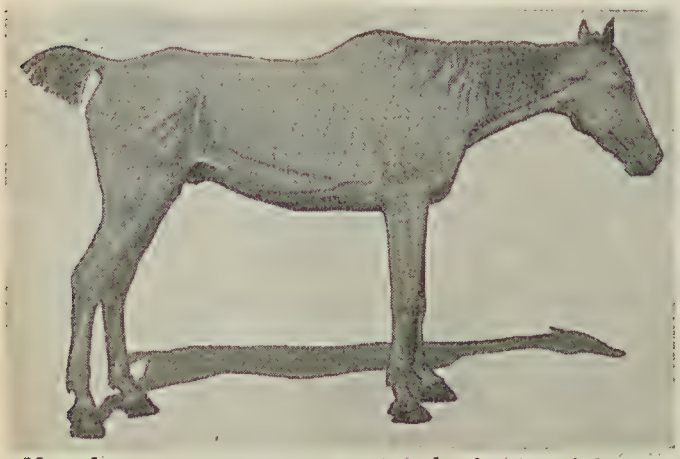
An important characteristic of the causal micro-organism of tetanus is its ability to form spores. These spores represent a resting stage in the life history of the germ, and they are markedly resistant to adverse conditions of heat and dryness and to the influence of disinfectants. They are present in soil, street dust, and manure, and may remain alive for considerable periods of time. Another characteristic of this organism is its inability to develop and grow except where air or oxygen is excluded, or where suitable conditions for growth are provided, through the presence of dead or damaged tissues.

When the spores of tetanus gain access to the tissues of a living animal, and suitable conditions for their germination and growth are present, rapid multiplication follows with the production of tetanus toxin. The absorption of this toxin, mainly through the nervous system, is followed by the appearance of the typical symptoms of the disease.

The almost universal presence of tetanus spores about stables and in manure, renders horses very liable to the infection which is generally introduced through wounds in the skin and feet. Occasionally mares may become infected through the contamination of the genital passages at parturition. It is not unusual that the point at which the organisms gain access to the body cannot be determined. This usually is due to the wound having healed superficially, and thus being difficult to find, or to the fact that it was originally so insignificant as to escape detection. The wounds produced during castration and docking, and the navel in foals are, if neglected, likely to

become infected with tetanus. In the case of castration, a dirty emasculator may actually inoculate the tetanus spores into the tissue crushed by the jaws of the instrument.

The time that elapses between the introduction of the infection and the onset of symptoms is known as the incubation period; in man this averages about nine days but may be shorter. In the horse and sheep it varies from three to twenty-one days.



Muscular spasms in a horse as a result of tetanus infection.

Symptoms.

The characteristic symptoms of tetanus are due to violent contractions of the body produced by the effect of the toxin on the nervous system. The muscles of the limbs become tense and rigid and if the animal is frightened it will stumble around and may even fall in a type of convulsion. When standing, the attitude simulates that of a trestle, that is, the legs are braced outwards. If the head be lifted up, the fleshy eyelid moves across the eye and the eyeball retracts in its socket. The muscles of the loins and back are rigid, and the patient, if turned around, moves like a door, instead of doubling round at the loins as a normal animal will do. The muscles of the jaws are affected also, and cause the symptom known as lockjaw: the patient is unable to open its jaws and hence normal feeding is impossible. The tetanic contractions affect all the muscles of the body, and among other symptoms arising from such a condition is a quickened shallow respiration.

In horses the most prominent symptom is nervousness or excitability. When the animal is approached, the head is thrown up, the ears move, and the eye looks wild because the fleshy eyelid or membrana shows prominently. Spasm-like convulsions may occur at intervals and difficulty is experienced by the horse in remaining on its feet, and should it fall a typical picture is presented—the head, neck, tail, and limbs being stretched out rigidly.

Treatment.

The patient should be placed in a darkened and quiet box, the floor being bedded with sawdust or other short bedding, and a full dose of aloes or other purgative should be given.

For those animals that take kindly to slings, slinging from the outset is of first importance. Those sedatives, which tend to clog up the eliminative organs, such as opium and its derivatives, should not be administered.

Chloral hydrate and camphor given either as an electuary (a powder mixed with treacle or honey), placed on the tongue, or as a suppository (a medicinal preparation which dissolves easily) administered per rectum are useful in combating the spasms. The dose of physic, by unloading the bowels, lowers blood pressure and facilitates the elimination of toxin from the body fluids. The patient might be given some whole root foods, such as carrots, mangels or swedes. The act of masticating the roots stretches the jaw to the maximum. In addition, nutrient sloppy food, gruels, &c., should be allowed at all times.

Where a wound is detected, it should be opened and thoroughly cleaned. The laying open of punctured wounds is essential, and all firmly adherent scabs must be removed. Hydrogen peroxide and tincture of iodine are excellent antiseptics for treatment of these wounds.

Foot Wounds.

Wounds in the feet of horses should never be neglected. An important point to note is that most hoof injuries produce very little pus, and one must not be lulled into false security by this feature. Any injury through the insensitive horn should be cleaned up—generally by opening up with a hoof knife—so as to allow drainage and subsequent application of dressings. Seedy toes should be scraped out until only good solid horn is left. Nail punctures must be cut out until the sensitive structures are exposed. Pure carbolic acid may

be used as a primary dressing followed by the continued use of tincture of iodine. Poulticing of the foot helps to draw infective material, and a similar result is obtained by the use of pads soaked in glycerine.

Natural Production of Anti-toxin.

In cases of tetanus, the animal body reacts against the toxin, and an endeavour is made to overcome the poison by the production of anti-toxin. Where infection is acute, the patient is unable to produce sufficient anti-toxin to neutralize the free toxin originating at the site of infection, and death results.

In cases that recover without aid the animal has been able to produce sufficient anti-bodies in the blood stream to neutralize the toxin produced by the germs.

Tetanus Anti-toxic Serum.

It is possible to produce Tetanus anti-serum artificially by hyperimmunizing horses against tetanus and then using the blood serum from these animals. When this process was first originated it was hoped that the administration of Anti-toxic serum would greatly assist in the recovery of affected animals. It has been found, however, that once symptoms of tetanus have developed the serum would require to be used in enormous doses to be of value. Its value as a preventive against tetanus, however, has been demonstrated. It produces its effect at once, and when administered immediately after infliction of a wound or before operations it is an almost infallible preventive.

Tetanus Toxoid.

A method of conferring a life-long immunity has been developed in recent times. This method consists of the use of a vaccine known as Tetanus Toxoid.

In France, where its use has been extensive, losses from the disease in stock have been completely checked.

One dose of this vaccine produces a high degree of immunity, but if a second injection be given twelve months later immunity is established for the life of the animal.

The use of this vaccine is desirable on properties in known tetanus areas, and all horses on such farms should be rendered immune.

In the treatment of cases of tetanus it is advised that a qualified practising veterinarian be consulted, as there are many aids that only the expert can give.

The dosage and administration of Anti-toxic serum should be left in the hands of the practitioner, and stock owners who have suffered losses of stock from this disease should consult a veterinarian in regard to the use of the Tetanus Toxoid or Vaccine, in order to render their horses immune to this serious malady.

Both Anti-serum and Toxoid are prepared in Australia at the Commonwealth Serum Laboratories.

Stable Management.

Greater attention paid to stable management and hygiene would lessen the incidence of tetanus cases in horses, and on farms where cases have occurred, it is advisable to clean out and disinfect stables regularly. The manure should be removed from horse yards at least weekly: old splintery posts should be replaced or be cleaned up with an adze: protruding nails and wire ends should be removed: machinery not in use should be kept in safe places.

Special attention should be paid to the hoofs of horses to prevent cracking and breaking away. This is done by the regular use of knife and rasp. A good horse master pays attention to his horses' feet as a matter of routine, and consequently, his charges are less likely to contract tetanus than are those of the careless owner.

Summary.

(1) Tetanus is not transferred directly from one animal to another.

(2) The mortality is high.

(3) The spore of the tetanus germ remains alive for years in soil, dust, and manure.

(4) Deep-seated or punctured wounds caused by an implement exposed to soil or manure, are likely to be followed by tetanus. All wounds in or around the hoofs are included in this category.

(5) The germs of tetanus remain localized at the site of infection, and the toxin or poison produced passes to the nervous system and produces symptoms.

(6) The use of Anti-toxic serum is recommended as a quick acting preventive agent in cases of foot wounds and other deep seated injuries.

(7) The use of Tetanus Toxoid to confer immunity for life is recommended for all horses on farms on which cases of the disease have occurred.

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Brands Registered for 1938

By W. C. Robertson, Chemist.

Lime and fertilizers are important factors for success in floriculture.

LIME may be used as a soil dressing in agriculture in three forms, viz.:—as the free oxide, the hydrate, and the carbonate. In the case of the oxide and hydrate there is always a small amount of carbonate present; while agricultural burnt lime will always contain hydrate and similarly the hydrate (or agricultural slaked lime) always contains a percentage of the oxide. On the other hand, the carbonate (ground limestone or chalk) does not contain any hydrate or free oxide unless they are deliberately added.

Lime mainly occurs in nature as calcium carbonate either in the rock form as marble or limestone or in the amorphous condition as chalk. When burnt in suitable kilns the rock or stone is converted into calcium oxide, which is the chemical term for lime, and which is generally known in the building trade as Roach, Fat, Caustic, Rock, Stone, or Quick Lime.

When lime (calcium oxide) is exposed to the weather it becomes air-slaked, which means that it combines chemically with the moisture and carbonic acid gas of the atmosphere to become a mixture of the three forms i.e., oxide, hydrate and carbonate. The extent of the reaction will depend upon the period of exposure. Lime in this condition is sold as slaked lime but strictly speaking slaked lime is calcium hydrate which consists of calcium oxide plus a fixed amount of water. Agricultural slaked lime on prolonged exposure becomes converted into the carbonate which is stable and may be kept in store on the farm without depreciating in value.

From the foregoing remarks, the user of lime in burnt and slaked forms will readily understand that it quickly reverts to the carbonate after application to the soil and, therefore, any comparison with the carbonate form should be based on the mechanical effect on the soil between the time of application and the conversion into carbonate (natural lime).

Agricultural lime in any form sold as such for use as a soil improver must not be confused with the lime or slaked lime which is sold for use as a fungicide or insecticide or for the purpose of manufacturing these commodities. Agricultural lime is entirely unsuitable for the latter.

In intense culture lime should be applied in quantities sufficient to produce the mellow soil necessary for the perfect growth which results not so much in increased yields as in an improvement in quality. It is also essential to apply lime to the soil periodically to replenish the loss through drainage which over a period of years may be considerable, especially in soils which are poor in lime.

An inch of rain showers 100 tons of water on every acre and it is estimated that this will dissolve about a half a hundredweight of lime from the first foot of soil. Assuming a rainfall of 20 inches per annum, the lime dissolved would amount to 10 cwt. per acre providing, of course, that the lime in the soil is not locked away in mineral combination. With a drainage loss of 33 per cent. yearly, the irretrievable loss in lime may amount to some hundredweights per acre—a quantity sufficient in itself to produce a lime deficiency after a period of years.

The brands of agricultural lime registered under the Lime Act for the current season are set out in the accompanying table. The list comprises brands of ground burnt lime (4). agricultural slaked lime (7) and ground limestone or chalk (8). The figures in brackets denote the number of brands registered in each division. Compared with the previous year's registrations there is a decrease in the number of brands registered under the headings of agricultural slaked lime and ground limestone with a fall in price of approximately 6 per cent. in the case of the former and 16.4 per cent in the latter.

Values for 1938.

Farmers are advised to buy lime on the unit value system. By dividing the percentage of lime, which is guaranteed and shown on the label attached to every bag of lime, into the price per ton (converted into pence for convenience) a figure is obtained which represents the cost of each one per cent. of lime per ton of agricultural lime. To illustrate: A manufacturer registers two brands of agricultural lime under the heading of ground limestone. They are termed No. 1 and No. 2. The question is which is the better to buy? No. 1 is guaranteed to contain 44.8 per cent of calcium oxide and the registered price is 25/- per ton. Then 25/- x 12 = 300 pence, and 300 pence divided by 44.8 = 6.7 pence, the cost of each one per cent. of lime. No. 2 is guaranteed to contain 30.8 per cent. of calcium oxide and is sold at 20/- per ton. Then 20/- x 12 = 240 pence which divided by 30.8 = 7.8 pence as the cost of one per cent. of lime in this brand of ground limestone.

A small lime works, situated on a main road, in a country district.

In this case the figures prove No. 1 to be the cheaper, but before buying, the unit value of other brands should be calculated and the agricultural lime giving the lowest cost for one per cent. of lime in its section should be selected as the best to buy. It may be assumed that lime of a higher quality than that guaranteed will not be supplied.

Calculating from the prices and analyses of the brands registered for the year 1938, the average cost of each one per cent. of lime per ton is as follows.

In agricultural burnt lime 8.35 pence (8.35).
In agricultural slaked lime 8.62 pence (9.15).
In ground limestone .. 6.52 pence (7.8).

The figures in brackets represent last year's cost.

The average content of lime and the average price per ton in each section for the current year are as follow:—

	Lime (CaO) per cent.	Cost. £ s. d.
Ground burnt lime	81.14	2 16 3
Slaked lime	61.70	2 4 4
Ground limestone or chalk	45.99	1 5 0

LIST OF AGRICULTURAL LIMES REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE AGRICULTURAL LIME ACT 1934 (No. 4271) FOR THE YEAR 1938.

General Description.	Brand.	Calcium Oxide.	In the Form of—	Equivalent to Calcium Carbonate.	Magnesium Oxide.	In the Form of—	Degree of Fineness. Material Passing Through a 20-mesh Sieve.	Price per Ton in 11-ton Lots.	Manufacturer.
		%		%	%		%	£ s. d.	
Agricultural Lime. Ground Burnt (unslaked)	Lilydale, No. 2	80·00	Mainly oxide	143·00	5·00	Mainly oxide	40·00	2 5 0	David Mitchell Estate, Oliver's-lane, Melbourne, C.1
" " "	" No. 1	87·70	"	156·90	5·00	"	40·00	3 0 0	David Mitchell Estate, Oliver's-lane, Melbourne, C.1
" " "	Peninsula, No. 3	73·08	"	130·40	1·28	"	98·00	3 0 0	Peninsula Lime and Fertiliser Co., 70 Elizabeth-street, Melbourne
" " "	Kawa ..	83·80	"	149·70	1·20	"	90·00	3 0 0	P. Alkemade and Sons, 535 Little Lonsdale-street, Melbourne
Slaked Lime	Lilydale ..	68·00	Mainly hydroxide	121·30	3·00	Mainly hydrate	70·00	1 15 0	David Mitchell Estate, Oliver's-lane, Melbourne, C.1
" " "	McCann's ..	60·00	"	107·00	1·10	"	80·00	1 15 0	John N. McCann Pty. Ltd., Kardinia-street, Geelong
" " ..	White Rock ..	60·00	Hydroxide and carbonate	107·00	2·00	"	70·00	2 0 0	White Rock Lime Co. Pty. Ltd., 19 Queen-street, Melbourne
" " ..	Snowflake ..	68·43	"	122·10	1·57	"	81·00	2 5 0	Evans Bros. Pty. Ltd., Yarra Bank-road, South Melbourne
" " ..	Bulldog ..	51·80	"	92·40	·80	"	65·00	2 5 0	Bulldog Lime Co. Pty. Ltd., 344 Swan-street, Richmond, E.1
" " ..	Peninsula A.G.	56·92	"	101·60	·99	"	100·00	2 10 0	Peninsula Lime and Fertiliser Co., 70 Elizabeth-street, Melbourne
" " ..	Kawa ..	66·70	Mainly hydrate	119·10	1·20	"	92·00	3 0 0	P. Alkemade and Sons, 535 Little Lonsdale-street, Melbourne
Ground Limestone or Chalk	Lilydale ..	50·00	Carbonate	89·50	3·00	Carbonate	95·00	1 2 6	David Mitchell Estate, Oliver's-lane, Melbourne, C.1
" " ..	Applim ..	51·10	"	91·20	1·20	"	98·00	1 5 0	Ammonia Products Pty. Ltd., 360 Collins-street, Melbourne
" " "	Walker's No. 1	44·80	"	80·00	·61	"	75·00	1 5 0	David Walker, Waverley Lime Works, Lara
" " "	" No. 2	30·80	"	55·00	3·00	"	75·00	1 0 0	David Walker, Waverley Lime Works, Lara
" " "	Lara ..	45·00	"	80·00	1·50	"	80·00	1 10 0	Lara Fertiliser and Lime Co., Lara
" " "	Kurdeez ..	44·80	"	80·00	·80	"	65·00	1 10 0	Victorian Agricultural Lime Ltd., 422 Collins-street, Melbourne
" " "	Kawa ..	51·40	"	91·70	1·20	"	75·00	1 5 0	P. Alkemade and Sons, 535 Little Lonsdale-street, Melbourne
" " "	Lilydale Lime Nibs	50·00	"	89·50	5·00	"	51·00	1 2 6	David Mitchell Estate, Oliver's-lane, Melbourne, C.1

London Markets

Weekly Prices

The following information as to prices offering in London for the principal Victorian primary products has been taken from cablegrams received each week by the Department of Agriculture from the Victorian Agent-General in London.

Product.	Price for Week Ending—			
	3rd December.	10th December.	17th December.	23rd December.
	d.	*d.*	*d.*	*d.*
Lamb, 1st quality, Victorian .. .. 29–36 lb. ..	8	8	8	7⅞
Lamb, 1st quality, Victorian .. .. 37–42 lb. ..	8	8	7⅞	7¾
Lamb, 1st quality, other States .. 29–36 lb. ..	7⅞	7⅞	7⅞	7¾
Lamb, 1st quality, other States .. 37–42 lb. ..	7⅞	7⅞	7⅞	7¾
Lamb, 2nd quality, Victorian .. .. 28 lb. and under	7½	7½	7½	7⅜
Lamb, 2nd quality, Victorian .. .. 29–36 lb. ..	7¼	7¼	7¼	7⅛
Lamb, 2nd quality, other States .. 28 lb. and under	7½	7½	7½	7⅜
Lamb, 2nd quality, other States .. 29–36 lb. ..	7¼	7⅛	7⅛	7⅛
Lamb, 3rd quality, all States .. .. 28 lb. and under	7	7	7	6⅞
Lamb, 3rd quality, all States .. .. 29 lb. and over	6⅝	6⅝	6⅝	6⅝
Mutton wethers and/or maiden ewes .. Under 40 lb. ..	4½	4½	4⅝	4¾
Mutton wethers and/or maiden ewes .. 41–48 lb. ..	4	4⅛	4¼	4¼
Mutton wethers and/or maiden ewes .. 49–56 lb. ..	3⅞	3⅞	4	4
Mutton ewes .. .. Under 40 lb. ..	4⅜	4½	4⅝	4⅝
Mutton ewes .. .. 41–48 lb. ..	3⅞	4	4	4
Beef, frozen ox hinds .. .. .. 145–210 lb. ..	4⅛	4⅛	4¼	4¼
Beef, frozen ox crops, weights corresponding	3¼	3¼	3⅜	3⅜
Beef, chilled ox hinds .. .. 145–210 lb. ..	5⅜	5⅛	5¼	5⅛
Beef, chilled ox crops, weights corresponding	3¾	3⅜	3¾	3¾
Pork, Australian 1st quality .. .. 60–80 lb. ..	7⅛	7⅜	7½	7⅝
Pork, Australian 1st quality .. .. 81–100 lb. ..	7⅛	7¼	7½	7½
Pork, New Zealand, 1st quality .. 60–80 lb. ..	7¼	7⅜	7½	7⅝
Pork, New Zealand, 1st quality .. 81–100 lb. ..	7¼	7⅜	7½	7½
	s.	*s.*	*s.*	*s.*
Bacon, Canadian .. .. .. per cwt. ..	89	89	89	89
Bacon, Empire (cured in England) .. per cwt. ..	89	89	89	89
Bacon, Danish .. .. .. per cwt. ..	95	97	97	100
Butter, unsalted, choicest grade .. per cwt. ..	116	112	114	112–114
Butter, unsalted, 1st grade .. .. per cwt. ..	114	110	..	111
Butter, unsalted, 2nd grade .. .. per cwt. ..	..	..	..	..
Butter, unsalted, pastry grade .. per cwt. ..	..	..	..	..
Butter, salted, choicest grade .. .. per cwt. ..	111–112	108–109	113	112–113
Butter, salted, 1st grade .. .. per cwt. ..	110–111	107–108	112	111–112
Butter, salted, 2nd grade .. .. per cwt. ..	110	106–107	110–111	110–111
Butter, salted, pastry grade .. .. per cwt. ..	107–108	104	108	108
Butter, Danish .. .. .. per cwt. ..	150	148	152	146
Market (butter)	Quiet	Steady demand at lower prices	Steady for available supplies	Quiet

Fertilizers Act

Registrations and Unit Values for 1938

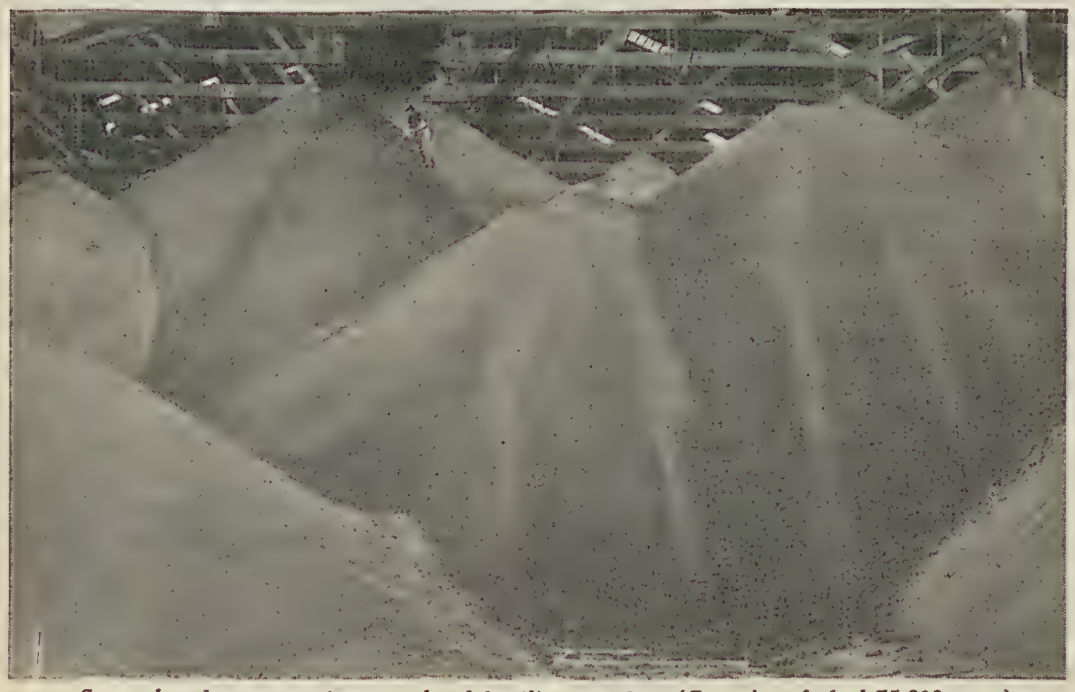
By W. C. Robertson, Chemist.

A KNOWLEDGE of artificial fertilizers, both as regards their composition and use, is most valuable to the producer irrespective of the particular branch of farming which he is practising or the type of soil tilled. It is of particular importance, however, to the specialist, the horticulturist, the market gardener, the floriculturist and all who earn their living from the intense culture of the soil.

Those who are working land of such exceptional fertility as some of the volcanic soils of the Western District and the rich alluvial flats of Bairnsdale, Orbost and Bacchus Marsh, may not require the assistance of fertilizers to the same extent as those occupying the poorer grades of land which constitute the bulk of the settled areas in the State. On the other hand, excellent responses to superphosphate have been obtained from pastures growing on rich soil. Generally speaking, artificial fertilizers give greater relative responses when applied to poor land—poor not only in its content of plant nutrients but also in its physical structure and aspect.

While a sound knowledge of agricultural chemistry is essential to one who wishes to become expert in the art of scientific manuring, it is not necessary in the case of the farmer who wishes to buy and use artificial fertilizers in a practical and economical manner.

Artificial fertilizers may be divided into three main classes, viz. :—(*a*) those supplying nitrogen (nitrogenous), in quantity, in a form which is more or less available, (*b*) those which mainly supply appreciable amounts of available phosphoric acid (phosphatic), and (*c*) those supplying a quantity of potash (potassic). The potash in potash fertilizers is soluble in water and therefore readily available.



Superphosphate maturing at a local fertilizer works. (Capacity of shed 75,000 tons.)

In the list of brands attached hereto are set out the guaranteed composition and price per ton of more than 130 brands of fertilizers. Of these, the ones in common use are superphosphate, ammonium sulphate, sodium nitrate and nitro-chalk, potassium sulphate and chloride (muriate), dried blood, blood and bone (tankage) and bonedust.

Apart from ground phosphate, which is rarely used, and one or two waste products, the remainder are blends or mixtures of the common fertilizers. In some cases these are mixed with the object of supplying nitrogen and phosphoric acid while in others the aim is to make a complete fertilizer containing the three plant foods, viz., nitrogen, phosphoric acid and potash all in readily available forms.

Based on their origin, the common fertilizers may be subdivided into mineral and organic, thus super, ammonium sulphate, sodium nitrate, nitro-chalk and the potash fertilizers comprise the mineral group while the animal fertilizers blood and bone, blood, and bonedust are of organic origin. It should be noted however,, that organic fertilizers always contain mineral matter which, in the case of blood and bone and in bonedust, amounts to a large percentage.

Generally speaking, the fertilizers of the mineral class should be regarded as stimulating in their effect and as particularly effective during the colder periods of the year, whereas the organic types require hot weather for best results and are therefore used mainly in the warmer months when soil temperatures, in conjunction with summer rains or irrigation, enhance their decomposition with a minimum of loss.

There are practical men with long experience in the beneficial effect of artificial fertilizers who have as their slogan "Use mineral fertilizers on the crop and manure the soil with the organic type.".

This amounts to stimulating the plant and re-inforcing the soil and is a good system providing the quantities used are judiciously controlled and cultivation of the surface soil is regularly practised, particularly after rain.

The Fertilizers Act requires that every artificial fertilizer which is retailed in Victoria must be sold under a registered brand and at the registered price per ton. All users of fertilizers are therefore advised to buy only the fertilizers which have a brand registered at the office of the Director of Agriculture. The main list for the current year appears in this issue.

From a survey of the registered brands, the fertilizers in their various sections may be readily compared both as regards quality and price per ton. However, to obtain an accurate comparison between brands of the one type or class, it is necessary to employ the unit value system, which is based on the average price and average guarantee of the brands of the simple fertilizers registered. It would be ridiculous to attempt to compare, say for example, dried blood with super., or super. with sulphate of potash, but a comparison between the various brands of blood and bone or between brands of bonedust and blood and bone will often prove useful.

Comparing the unit values for 1938 with the figures for the previous year, an alteration will be observed in the figures for the main organic fertilizers, i.e., blood, blood and bone, and bonedust while all other values, except a slight variation in potash as sulphate, remain constant. The price of nitrogen in these fertilizers has increased 7½ per cent. with a consequential increase of 9 per cent. for the same element in coarse bone. The unit for citrate soluble phosphoric acid in blood and bone (animal fertilizer) has increased 12·5 per cent. On the other hand the units for phosphoric acid in fine and coarse bone, which may be regarded as equivalent to citrate soluble and citrate insoluble, show decreases of 6 and 12·5 per cent. respectively.

These alterations are due to (1) an alteration in works practice and (2) the demand for meat meal for use as stock food, causing a shortage of raw material.

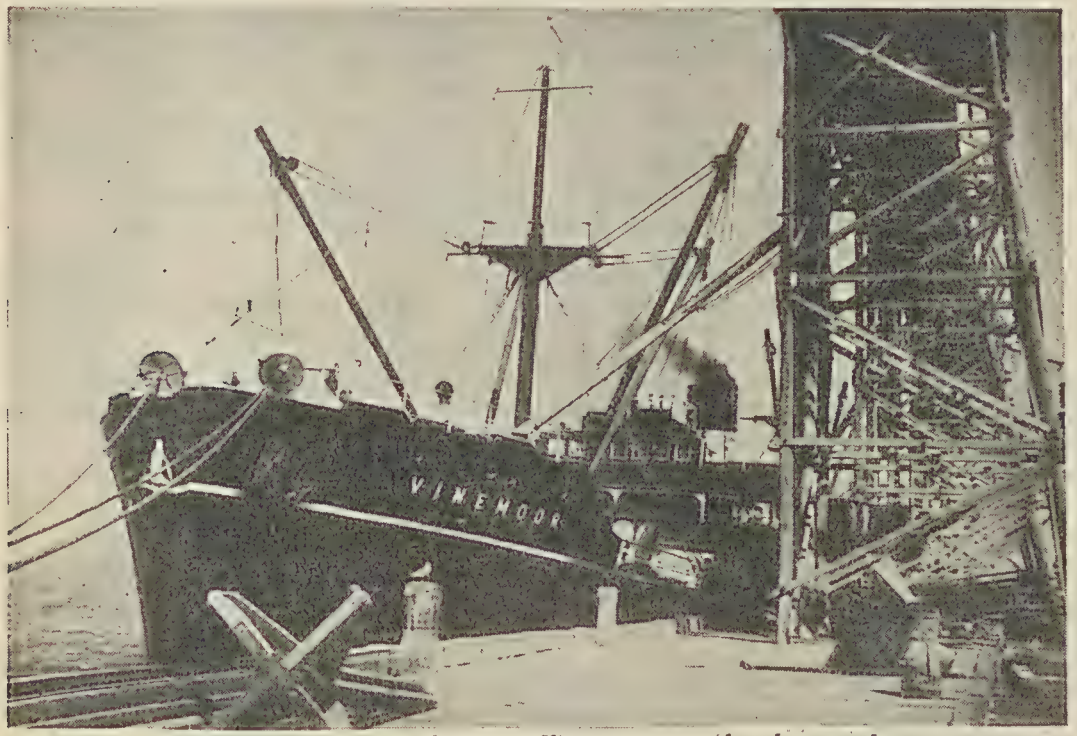
Unit Values.

The unit value for a given plant food in any fertilizer is the average cost (commercial value) of each one per cent. per ton. To obtain the commercial value of a fertilizer, it is only necessary to multiply the percentage of each plant food by the unit value. In the case of mixed fertilizers, an allowance should be made for the cost of mixing, &c.

The following are examples of the usefulness of the unit value system :—

> A brand of dried blood is guaranteed to contain 12 per cent. nitrogen. Then 12 × 20/1 (the unit value of nitrogen as blood) = £12 1s. which means that the commercial value of this brand of fertilizer is £12 1s. per ton and at any figure under this price it is worth buying.

In a similar manner the values for brands of blood and bone may be determined. For instance, blood and bone A is sold under a guaranteed analysis of 5·25 per cent. nitrogen as



Unloading rock phosphate at a Victorian superphosphate works.

bone, flesh and blood, 3 per cent. phosphoric acid as citrate soluble and 9 per cent. as citrate insoluble, then—

	£ s. d.
5·25 per cent. N. × 20/1 (Unit value)	= 5 5 5
3·00 per cent Citrate Soluble Phosphoric Acid × 4s. 6d. (Unit value)	= 0 13 6
9·00 per cent. Citrate Insoluble Phosphoric Acid × 3s. 6d. (Unit value)	= 1 11 6
Commercial value per ton ..	= 7 10 5

and blood and bone brand B with a guarantee of 5·4 per cent. nitrogen as blood and bone, 8·50 per cent. citrate soluble phosphoric acid and 5·50 per cent. citrate insoluble phosphoric acid will give the following figures :—

5·4 per cent. N. × 20/1 (Unit value)	= 5 8 5
8·5 per cent. Phosphoric Acid Citrate Soluble × 4s. 6d. (Unit value)	= 1 18 3
5·5 per cent. Phosphoric Acid Citrate Insoluble × 3s. 6d. (Unit value)	= 0 19 3
	8 5 11

This brand may be assumed to be cheap at any figure under £8 5s. 11d. per ton.

The value of the system becomes apparent however when the retail registered prices of the two brands A and B are considered. Brand A with a calculated value of £7 10s. 5d. has a registered price of £9 10s. per ton. Brand B with a calculated value of £8 5s. 11d. is retailed at the registered price of £7 10s. per ton, and the farmer buying this brand is gaining 15s. 6d. in quality with a saving of two pounds in price—an economical gain of £2 15 6d. per ton.

Bonedust is valued on its mechanical condition (fineness) in addition to its chemical composition and the calculations must be varied accordingly. As the plant foods in fine bone have a higher value than in coarse bone, it is necessary to calculate from the mechanical condition of the bonedust the amount of nitrogen and phosphoric acid occurring in the fine and coarse particles of the fertilizer. This is done by multiplying the percentages of nitrogen and phosphoric acid by the percentage of fine bone and moving the decimal point two places to the left. The resulting figure is the percentage of plant food as fine bone which when subtracted from the total percentage of plant food will give the percentages of nitrogen and phosphoric acid as coarse bone.

To illustrate :—A brand of bonedust which has a registered brand guarantee of 2·5 per cent. nitrogen, 20 per cent. phosphoric acid with 51·5 per cent. fine bone and 48·5 per cent. coarse bone would have the following commercial value worked out on the unit value system. Thus, 2·5 per cent. nitrogen × 51·5 per cent. of fine material = 1:29 per cent. of nitrogen as fine bone and 1·29 subtracted from 2·5 = 1.21 per cent. nitrogen as coarse bone.

Calculating in the same way with the phosphoric acid :—20 per cent. phosphoric acid × 51·5 per cent. fine material = 10·30 (after moving the decimal two points to the left) as the percentage of phosphoric acid as fine bone and 10·30 subtracted from 20 (percentage of total phosphoric acid) = 9·7 per cent. as coarse bone.

Then—

	£	s.	d.
1·29 % N as fine bone × 20/1 (unit value of N in fine bone) =	1	5	11
1·21 % N as coarse bone × 18s. (unit value in coarse bone) .. =	1	1	9
10·30 % Phos. Acid as fine bone × 4/6 (unit value in fine bone) =	2	6	4
and 9·70 % Phos. Acid as coarse bone × 3/6 (unit value in coarse bone) .. .. .. =	1	14	0
Giving the calculated value per ton of ..	6	8	0

The registered price of this brand of bonedust with its comparatively low content of nitrogen is £6 per ton, which makes its purchase worth considering.

Fertilizers Act 1928 (No. 3680).

UNIT VALUES FOR THE YEAR 1938.

	£	s.	d.
Nitrogen, organic, as Blood ; Blood and Bone ; Blood, Bone, and Flesh ; and Fine Bone ..	1	0	1
,, as Coarse Bone and in Bone Fertilizers	0	18	0
,, as Nitrate	0	17	4
,, as Ammonia	0	11	4
Phosphoric Acid—			
as Water Soluble	0	3	7
as Citrate Soluble—			
in Blood and Bone and Animal Fertilizers and in Mixed and Complete Fertilizers containing either or both of the foregoing	0	4	6
in all other Fertilizers	0	3	0
as Citrate Insoluble—			
in Blood and Bone and Animal Fertilizers, and in Mixed and Complete Fertilizers containing either or both of the foregoing	0	3	6
in other Mixed Fertilizers and in Ground Phosphate	0	2	2
in other Fertilizers	0	1	0
as Fine Bone	0	4	6
as Coarse Bone	0	3	6
Potash—			
as Sulphate	0	6	1
as Chloride	0	5	2

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1938.

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
Nitrogenous—Readily Available.		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Nitrate of Soda	Sickle in diamond	15·50	..	..	..	..	15·50	..	..	..	..	..	13 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
,, ,,	Cresco ..	15·50	..	..	..	..	15·50	..	..	..	..	..	13 10 0	Cresco Fertilizers Ltd., Geelong
,,	Pivot ..	15·50	..	..	..	..	15·50	..	..	..	..	..	13 10 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
,, ,,	Champion ..	15·50	..	..	..	..	15·50	..	..	..	..	..	13 10 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1938—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*			Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble	As Citrate Insoluble.	Total.		£	s.	d.	
Nitrogenous—Readily Available.—continued.		%	%	%	%	%	%	%	%	%	%	%				
Sulphate of Ammonia	M.G. Co. in diamond	..	20·59	..	..	..	20·59	..	..	..	..	..	11	9	0	The Metropolitan Gas Co., 196 Flinders-st., Melbourne
„ „	Pivot ..	..	20·60	..	..	..	20·60	..	..	..	..	..	11	15	0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
„ „	Sickle in diamond	..	20·60	..	..	..	20·60	..	..	..	..	..	11	15	0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-street., Melb.
„ „	Cresco ..	..	20·60	..	..	..	20·60	..	..	..	..	..	11	15	0	Cresco Fertilizers Ltd., Geelong
Nitro Chalk† ..	Sickle in diamond	7·75	7·75	..	..	..	15·50	..	..	..	..	..	11	15	0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
Moderately Available.																
Dried Blood ..	Imperial in diamond	..	..	12·00	..	..	12·00	..	..	..	..	..	11	0	0	W. Angliss and Co. (Aust.) Pty. Ltd., 42 Bourke-st., Melbourne
„ „ ..	T.B. & S. in diamond—Brooklyn	..	..	12·00	..	..	12·00	..	..	..	..	..	13	10	0	Thos. Borthwick and Sons (A/asia) Ltd., 84 William-st., Melbourne
„ „ ..	M.C.C. in diamond	..	..	11·50	..	..	11·50	..	..	..	..	..	9	10	0	Melbourne City Council, Town Hall, Melbourne
„ „ ..	Pannifex's ..	..	..	12·00	..	..	12·00	..	..	·50	·50	1·10	12	10	0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
„ „ ..	Pannifex's Blood Flour	..	..	13·00	..	..	13·00	..	..	..	..	..	12	10	0	
Blood Manure ..	Sickle in diamond	..	..	7·50	..	..	7·50	..	..	..	..	..	9	0	0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
„ „ ..	Nifex ..	..	..	7·50	..	..	7·50	..	..	1·00	1·00	·25	8	10	0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
Slowly Available.																
Castor Meal ..	Alba ..	..	..	..	..	..	4·50 (as castor meal)	..	..	2·25	2·25	0·75	4	0	0	Lycett Proprietary Ltd., Normanby-road, Montague
„ „ ..	Pannifex's ..	..	..	..	..	..	4·50 (as castor meal)	..	..	2·25	2·25	·75	4	0	0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
„ „ ..	Sweetsoil ..	..	..	..	..	..	4·50 (as castor meal)	..	..	2·25	2·25	·75	4	0	0	Sweetsoil Lime and Fertilizers Pty. Ltd., 17 Queen-st., Melbourne
„ „ ..	L.F.X. ..	..	..	..	..	..	4·50 (as castor meal)	..	..	2·25	2·25	·75	4	0	0	Lawford's Fruit Exchange Pty. Ltd., Doncaster
Wool Waste ..	A.L.T. ..	..	..	..	..	..	3·85 (unspecified)	..	..	·70	·70	·31	2	15	0	A. L. Thompson Pty. Ltd., 49 Grant-st., South Melbourne
Phosphatic—Readily Available.																
Superphosphate 22 per cent.	Cresco ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3	15	0	Cresco Fertilizers Ltd., Geelong
„ „	Sickle in diamond	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3	15	0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
„ „	Pivot ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3	15	0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
„ „	Lamaco ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3	15	0	New Zealand Loan and Mercantile Agency Co. Ltd., 538 Collins-st., Melbonrne
„ „	Cockbills ..	..	..	..	..	..	..	20·50	·50	1·00	22·00	..	3	15	0	W. and J. Cockbill (trading as J. Cockbill), 407 Post Office-place, Melbourne

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1937—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Phosphate—Moderately Available.														
Basic Phosphate	Sickle in diamond	..	..	..	..	..	..	..	15·50	3·20	18·70	..	4 15 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
,, ,,	Pivot ..	..	..	..	..	..	..	..	15·50	3·00	18·50	..	4 15 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
Super. and Rock Phosphate	Pivot ..	..	..	..	..	..	..	10·00	·30	18·50	29·00	..	4 5 0	,, ,, ,,
,, ,,	Cresco 50/50 Phosphate	..	..	..	..	..	..	9·16	1·84	17·40	28·40	..	4 5 0	Cresco Fertilizers Ltd., Geelong
,, ,,	Sickle in diamond	..	..	..	..	..	..	10·00	·50	18·50	29·00	..	4 5 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
Slowly Available.														
Ground Phosphate	Sickle in diamond (80%)	..	..	..	..	..	..	..	..	36·65	36·65	..	4 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
,, ,,	Pivot ..	..	..	..	..	..	..	..	..	36·50	36·50	..	3 15 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
,, ,,	Pivot (very fine)	..	..	..	..	..	..	..	..	36·50	36·50	..	4 0 0	,, ,, ,,
Potassic—Readily Available.														
Sulphate of Potash	Cresco ..	..	..	..	..	..	..	..	..	..	..	48·50	15 0 0	Cresco Fertilizers Ltd., Geelong
,, ,,	Pivot ..	..	..	..	..	..	..	..	..	..	..	48·50	15 0 0	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
,, ,,	Sickle in diamond (90%)	..	..	..	..	..	..	..	..	..	..	48·50	15 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
,, ,,	Pannifex's ..	..	..	..	..	..	..	..	..	..	..	48·50	15 0 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
,, ,,	Sun ..	..	..	..	..	..	..	..	..	..	..	48·6	13 16 0	Mildura Co-operative Fruit Co. Ltd., Mildura
Muriate of Potash	Sickle in diamond (80%)	..	..	..	..	..	..	..	..	..	..	50·00 (as chloride)	13 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
,, ,,	Cresco ..	..	..	..	..	..	..	..	..	..	..	50·00 (as chloride)	13 0 0	Cresco Fertilizers Ltd., Geelong
,, ,,	Pannifex's ..	..	..	..	..	..	..	..	..	..	..	50·00 (as chloride)	13 0 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
Containing Nitrogen and Phosphoric Acid—Readily Available.														
Super. and Ammonia	Cresco (1 and 1)	..	10·30	..	..	..	10·30	10·25	·25	·50	11·00	..	8 5 6	Cresco Fertilizers Ltd., Geelong
,, ,,	Cresco (2 and 1)	..	6·87	..	..	..	6·87	13·66	·34	·66	14·66	..	7 0 0	,, ,, ,,
,, ,,	Cresco (3 and 1)	..	5·00	..	..	..	5·00	15·37	..	1·13	16·50	..	6 6 6	,, ,, ,,
,, ,,	Cresco (6 and 1)	..	2·85	..	..	..	2·85	17·48	·42	·85	18·75	..	5 10 6	,, ,, ,,
,, ,,	Pivot III. ..	..	10·00	..	..	..	10·00	10·20	·20	·50	10·90	..	8 5 6	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
,, ,,	Pivot II. (A) ..	..	6·80	..	..	..	6·80	13·60	·30	·60	14·50	..	7 0 0	,, ,, ,,
,, ,,	Pivot II. ..	..	5·00	..	..	..	5·00	15·30	·30	·80	16·40	..	6 6 6	,, ,, ,,
,, ,,	Pivot I. ..	..	2·90	..	..	..	2·90	17·40	·40	·80	18·60	..	5 10 6	,, ,, ,,

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3630) FOR THE YEAR 1938—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Readily Available.—continued.														
Super. and Ammonia	Sickle in diamond (1 and 1)	..	10·30	..	..	..	10·30	10·25	·25	·50	11·00	..	8 5 6	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
" "	Sickle in diamond (2 and 1)	..	6·87	..	..	..	6·87	13·66	·34	·66	14·66	..	7 0 0	" " "
" "	Sickle in diamond (3 and 1)	..	5·00	..	..	..	5·00	15·40	·30	·80	16·50	..	6 6 6	" " "
" "	Sickle in diamond (4 and 1)	..	2·00	..	..	..	2·90	17·50	·40	·90	18·80	..	5 10 6	" " "
Nitro Superphosphate	Sickle in diamond	..	1·50	..	..	·50	2·00	16·70	1·10	2·00	19·80	..	5 17 6	" " "
" ..	Cresco .	..	1·50	..	·50	..	2·00	16·39	1·10	1·70	19·19	..	5 17 6	Cresco Fertilizers Ltd., Geelong
Moderately Available.														
Ammonia and Rock Phosphate	Cresco ..	..	2·00	..	..	..	2·00	8·30	1·60	15·70	25·60	..	5 5 6	" " "
Blood, Bone, and Super.	Sickle in diamond	..	..	..	..	2·50	2·50	12·51	1·43	2·96	16·90	..	6 7 6	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
" "	Cockbill's ..	..	..	..	2·50	..	2·50	12·51	1·43	2·96	16·90	..	9 0 0	W. and J. Cockbill (trading as J. Cockbill), 407 Post Office-place, Melbourne
" "														
Bone and Super.	Dundas' ..	..	..	..	..	2·23	2·23	9·99	5·16	5·58	20.73	..	7 10 0	J. A. Dundas, Dynon-rd., Footscray
" "	Sickle in diamond, No. 1	..	..	..	..	2·00	2·00	11·40	3·00	5·30	19·70	..	6 10 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
" "	G.B.P. ..	..	..	..	1·72	..	1·72	10·00	6·00	6·00	22·00	..	6 17 6	Gippsland Bone Products, Ronchi Bros., Raymond-st., Sale
" "	Cresco No. 1 ..	..	..	..	2·00	..	2·00	9·50	3·90	3·00	16·40	..	6 10 0	Cresco Fertilizers Ltd., Geelong
Super. and Bone	Cresco No. 2 ..	..	..	..	..	1·00	1·00	16·10	1·10	3·60	20·80	..	5 15 0	Cresco Fertilizers Ltd., Geelong
" "	Sickle in diamond, No. 2	..	..	..	..	1·00	1·00	17·00	1·40	1·90	20·30	..	5 15 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
Bone Fertilizer and Super.	Elsworth's ..	..	..	..	..	1·50	1·50	11·00	2·50	5·00	18·50	..	6 0 0	W. R. Elsworth, cr. York and Joseph sts., Ballarat
Blood and Bone	Sickle in diamond	..	..	..	..	5·00	5·00	..	5·09	9·00	14·00	..	8 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
" "	J. A. Dundas'	..	..	..	..	4·50	4·50	..	7·14	13·61	20·75	..	8 0 0	J. A. Dundas, Dynon-rd., Footscray
" "	Corio ..	..	..	..	4·00	..	4·00	..	6·00	8·00	14·00	..	6 0 0	The Corio Trading Co. Pty. Ltd., 164 Moorabool-street, Geelong
" "	Cockbill's ..	..	..	..	..	5·25	5·25	..	3·00	9·00	12·00	..	9 10 0	W. and J. Cockbill (trading as J. Cockbill), 407 Post Office-place, Melbourne
" "	Imperial in diamond	..	..	..	4·50	..	4·50	..	6·00	12·00	18·00	..	7 10 0	W. Angliss and Co. (Aust.) Pty. Ltd., 42 Bourke-st., Melbourne
" "	W. & M. in circle	..	..	..	5·00	..	5·00	..	4·50	7·50	12·00	..	7 0 0	Western and Murray Co-operative Bacon and Meat Packing Co. Ltd., 522 Flinders-lane, Melbourne
" "	Pridham's ..	..	..	..	5·40	..	5·40	..	8·50	5·50	14·00	..	7 10 0	W. Pridham Pty. Ltd., Evans-st., Braybrook
" "	Ibis	..	..	..	..	3·02	3·02	..	4·71	5·49	10·20	..	6 12 6	Ficken, Halliday and McClelland Pty. Ltd., 271 Collins-st., Melbourne
" "	P.M. ..	..	..	..	..	7·50	7·50	..	6·31	5·69	12·00	..	9 0 0	J. Kitchen and Sons Pty. Ltd., Ingles-st., Port Melbourne
" "	Cockatoo ..	..	..	..	4·56	..	4·56	..	5·90	5·88	11·78	..	6 0 0	R. Fordham, Cressy-rd., Camperdown

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1938—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*			Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.		£	s.	d.	
		%	%	%	%	%	%	%	%	%	%	%				
Moderately Available—continued.																
Blood and Bone	Champion No. 2	..	..	..	7·00	..	7·00	..	3·20	10·20	13·40	..	9	0	0	Sims Cooper (Freezing Works) Pty. Ltd., Henty House, 499 Lit. Collins-st., Melbourne.
" "	Champion No. 4	..	..	..	6·50	..	6·50	..	6·50	7·50	14·00	..	8	10	0	" " "
" "	Fitzgerald's ..	..	..	..	5·00	..	5·00	..	5·50	9·50	15·00	..	8	0	0	P. Fitzgerald and Sons, Oakleigh
" "	T.B. and S. in diamond (Lighthouse)	..	..	..	6·00	..	6·00	..	5·00	5·00	10·00	..	8	10	0	Thos. Borthwick and Sons (A'asia) Ltd., 84 William-st., Melbourne
" "	T.B. and S. in diamond (Brooklyn)	..	..	..	5·75	..	5·75	..	5·75	6·00	11·75	..	8	10	0	" " "
" "	Eclipse ..	..	..	..	..	2·98	2·98	..	9·96	6·86	16·82	..	7	0	0	T. A. Mills, Spec Gully, Golden Square
" "	Apex ..	..	..	..	..	5·00	5·00	..	5·00	10·00	15·00	..	7	10	0	North-Eastern Bone Products, Wangaratta
" "	Fitzgerald's (animal fertilizer)	..	..	..	3·15	..	3·15	..	6·15	13·50	19·65	..	8	0	0	P. Fitzgerald and Sons, Oakleigh
" "	Pannifex's No. 1	..	..	..	..	5·50	5·50	..	8·00	6·00	14·00	..	7	15	0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
" "	Pannifex's No. 2	..	..	..	..	7·00	7·00	..	5·00	6·00	11·00	..	9	0	0	" " "
" "	Pannifex's No. 3	..	..	..	..	5·50	5·50	..	5·00	10·00	15·00	..	8	0	0	" " "
" "	Pannifex's No. 4	..	..	..	..	6·00	6·00	..	5·00	7·00	12·00	..	8	0	0	" " "
" "	Pannifex's No. 5	..	..	..	..	8·00	8·00	..	3·00	5·00	8·00	..	9	0	0	" " "
" "	Pannifex's No. 6	..	..	..	..	6·00	6·00	..	6·00	10·00	16·00	..	8	10	0	" " "
" "	Pannifex's No. 7	..	..	..	..	4·00	4·00	..	7·00	9·00	16·00	..	7	10	0	" " "
" "	Pannifex's No. 8	..	..	..	..	4·50	4·50	..	6·00	10·00	16·00	..	7	15	0	" " "
" "	Pannifex's No. 9	..	..	..	..	7·00	7·00	..	4·00	5·00	9·00	..	9	0	0	" " "
" "	Pannifex's No. 10	..	..	..	..	7·50	7·50	..	6·31	5·69	12·00	..	9	0	0	" " "
" "	Pannifex's No. 14	..	..	..	..	5·00	5·00	..	6·00	8·00	14·00	..	7	15	0	" " "
" "	Pannifex's No. 15	..	..	..	..	7·00	7·00	..	6·00	8·00	14·00	..	9	0	0	" " "
" "	Arch No. 1 ..	..	..	..	7·00	..	7·00	..	4·50	5·50	10·00	..	8	0	0	Amalgamated Freezing Co. (Vic.) Pty. Ltd., 54 Market-st., Melbourne
" "	Arch No. 2 ..	..	..	..	7·50	..	7·50	..	3·00	3·00	6·00	..	8	0	0	" " "
" "	Cresco ..	..	..	..	..	5·00	5·00	..	5·00	9·00	14·00	..	8	0	0	Cresco Fertilizers Ltd., Geelong
" "	F.F.M. in diamond A.B.	..	..	..	..	5·50	5·50	..	8·50	5·50	14·00	..	7	10	0	F. F. MacDermott Pty. Ltd., 54 Market-st., Melbourne
" "	Bendigonian in circle	..	..	..	4·00	..	4·00	..	6·00	13·00	19·00	..	7	10	0	Bendigo Fertilizer and Wool Co. Pty. Ltd., View Point, Bendigo
" "	Tongala ..	..	..	..	..	4·36	4·36	..	6·25	6·84	13·09	..	6	10	0	L. L. Russell and Son, Tongala
Blood and Bone	A.N.A. Surprise	..	..	..	..	5·00	5·00	..	4·00	10·00	14·00	..	8	0	0	G. W. Pennell, Burke-st., Braybrook
Bone Fertilizer	Elsworth's ..	..	..	..	..	4·00	4·00	·50	5·80	11·70	18·00	..	7	0	0	W. R. Elsworth, cr. York and Joseph streets, Ballarat
" "	Newnham's ..	..	..	..	..	..	2·28 (as bone)	..	6·86	16·72	23·58	..	5	0	0	Newnham Pty. Ltd., Box 8, P.O., Sale
Mixed Manure	Humo-Phos. ..	..	1·28	..	..	1·03 (organic)	2·31	..	..	5·46	5·46	..	4	0	0	Peninsula Lime and Fertiliser Co., 70 Elizabeth-st., Melbourne
Containing Nitrogen, Phosphoric Acid, and Potash																
Complete Manure	Sickle, No. 1 ..	..	1·00	..	..	1·40	2·40	12·50	1·70	2·10	16·30	5·00 (as muriate)	7	2	6	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne

LIST OF FERTILIZERS REGISTERED AT THE OFFICE OF THE DIRECTOR OF AGRICULTURE UNDER THE FERTILIZERS ACT 1928 (No. 3680) FOR THE YEAR 1938—*continued.*

Description of Fertilizer.	Brand.	Nitrogen.						Phosphoric Acid.				Potash as Sulphate.	Price asked per ton.*	Where Obtainable.
		As Nitrate.	As Ammonia.	As Blood.	As Blood and Bone.	As Blood, Bone, and Flesh.	Total.	As Water Soluble.	As Citrate Soluble.	As Citrate Insoluble.	Total.			
		%	%	%	%	%	%	%	%	%	%	%	£ s. d.	
Containing Nitrogen, Phosphoric Acid, and Potash.—Contd.														
Complete Manure	Sickle in diamond, No. 2	..	1·00	..	..	1·00	2·00	14·80	·40	·70	15·90	4·80	7 0 0	Commonwealth Fertilizers and Chemicals Ltd., 65 William-st., Melbourne
„ „	Sickle in diamond (Market Garden)	..	1·70	..	..	1·50	3·20	11·50	2·50	3·10	17·10	2·42	7 7 6	„ „ „
„ „	Sickle in diamond (A) (5.1.1.)	..	2·90	..	..	..	2·90	14·60	·40	·70	15·70	6·90	7 1 6	„ „ „
„ „	Sickle in diamond (B) (5.2.1)	..	5·00	..	..	..	5·00	12·80	·30	·60	13·70	6·00	7 19 0	„ „ „
„ „	Sickle in diamond (C) (4.4.1)	..	9·15	..	..	..	9·15	9·11	·22	·44	9·77	5·39	9 5 0	„ „ „
„ „	Sickle in diamond (D) (2.2.1)	..	8·24	..	..	..	8·24	8·20	·20	·40	8·80	10·00 (unspecified)	9 14 0	„ „ „
„ „	Pivot IV. ..	..	2·90	..	..	..	2·90	14·30	·30	·70	15·30	6·90	7 1 6	The Phosphate Co-operative Co. of Aust. Ltd., 447 Little Collins-st., Melbourne
„ „	Pivot V. ..	..	8·20	..	..	..	8·20	8·20	·20	·40	8·80	9·60	9 14 0	„ „ „
„ „	Pivot VI. ..	..	9·10	..	..	..	9·10	9·10	·20	·40	9·70	5·30	9 5 0	„ „ „
„ „	Cresco No. 1 ..	..	1·00	..	1·40	..	2·40	11·25	2·00	4·50	17·75	5·00	7 2 6	Cresco Fertilizers Ltd., Geelong
„ „	Cresco (Market Garden)	..	1·50	..	1·56	..	3·06	11·65	1·49	3·26	16·40	2·42	7 7 6	„ „ „
„ „	Cresco, No. 2 ..	..	9·15	..	..	..	9·15	9·11	·22	·44	9·77	5·39	9 5 0	„ „ „
„ „	Cresco, No. 3 ..	..	5·15	..	..	..	5·15	12·81	·31	·63	13·75	6·06	7 19 0	„ „ „
„ „	Cresco, No. 4 ..	..	8·24	..	..	..	8·24	8·20	·20	·40	8·80	10·00 (as muriate)	9 14 0	„ „ „

Description of Fertilizer.	Brand.	Nitrogen.	Phosphoric Acid.	Mechanical Condition.		Price asked per ton.*	Where Obtainable.
				Fine Bone.	Coarse Bone.		
		%	%	%	%	£ s. d.	
Bonedust ..	Pannifex's No. 1	1·00	30·00	95·0	5·0	8 10 0	H. C. Pannifex and Co. Pty. Ltd., 4 Dudley-st., Melbourne
„ ..	Pannifex's No. 2	3·50	19·00	50·0	50·0	8 5 0	„ „ „ „ „ „
„ ..	G.B.P. ..	3·44	24·00	65·0	35·0	8 10 0	Gippsland Bone Products, Raymond-st., Sale
„ ..	Mount Clear ..	3·00	19·00	50·0	50·0	6 10 0	Bailey Bros., 6 Sturt-st., Ballarat
„ ..	Nuclife ..	3·50	22·00	50·0	50·0	7 15 0	E. F. Peters and Sons Pty. Ltd., Dunolly
„ ..	Pioneer ..	3·82	21·96	50·0	50·0	7 10 0	W. A. Rainey, Mepunga East
„ ..	Apex ..	3·25	20·00	50·0	50·0	7 10 0	North-Eastern Bone Products, Wangaratta
„ ..	Eclipse ..	3·27	24·59	69·4	30·6	7 0 0	T. A. Mills, Spee Gully, Golden Square
„ ..	Cockbill's ..	2·50	19·25	50·0	50·0	9 10 0	W. and J. Cockbill, trading as J. Cockbill, 407 Post Office-pl., Melbourne
„ ..	Corio ..	2·50	20·00	51·5	48·5	6 0 0	The Corio Trading Co. Pty. Ltd., 164 Moorabool-st., Geelong
„ ..	Benson's B ..	3·25	23·20	50·0	50·0	6 10 0	T. Benson, Woodford

* F.O.R. at Melbourne or Railway Station nearest place of manufacture.——† This fertilizer contains approximately 50 per cent. of lime.

Melbourne, 26th November, 1937.

W. R. JEWELL, M.Sc., F.I.C.,
Chemist for Agriculture.

Butter Production and Export

The following table shows :—

(*a*) Factory production of butter and cheese in Victoria for the period July to October, 1937, compared with the corresponding period of 1936; and

(*b*) Quantities and percentages of various grades of bulk butter examined in Victoria for export from 1st July, 1937, to 27th November, 1937, in comparison with the corresponding period of 1936.

FACTORY PRODUCTION OF BUTTER AND CHEESE IN VICTORIA (QUANTITIES IN TONS).

Month.	Butter.		Cheese.	
	1937.	1936.	1937.	1936.
July and August	5,893	5,986	653	614
September	6,000*	6,725	719*	527
October	8,750†	8,635	1,009†	748
Totals, 4 months	20,643†	21,346	2,381†	1,889

* Revised. † Subject to revision.

BULK BUTTER EXAMINED IN VICTORIA FOR EXPORT (QUANTITIES IN TONS).

Period.	1937–38. How Graded—				Total.	Period.	1936–37. How Graded—				Total.
	Ch.	1st.	2nd.	Pty.			Ch.	1st.	2nd.	Pty.	
1st July to 30th October	7586	1757	402	17	9762	1st July to 31st October	7076	2804	592	62	10,534
31st October to 27th November	4469	2228	335	22	7054	1st November to 28th November	4929	1385	366	39	6,719
Totals 1st July to 27th November	12055	3985	737	39	16816	Totals 1st July to 28th November	12005	4189	958	101	17,253
Percentages	71·7	23·7	4·4	0·2	..	Percentages	69·6	24·3	5·5	0·6	..

Tubercle Free Herds

The following herds have been declared free of tuberculosis under the scheme conducted by the Department of Agriculture. Under this scheme a tuberculosis-free accredited herd of cattle is one in which the entire herd has passed two negative, successive, annual physical examinations and tuberculin tests, or, upon disclosure of infection, three semi-annual, successive physical examinations and tuberculin tests applied by a State Veterinarian or by a qualified and registered veterinarian who is approved by the Chief Veterinary Inspector for that purpose.

ACCREDITED TUBERCLE FREE HERDS.

Herd Number.	Name.	Address.	Number in Herd.	Herd Number.	Name.	Address.	Number in Herd.
1	State Research Farm	Werribee	259	6	Reid, Ralph G.	"Holmwood," Koo-wee-rup	99
2	Warragul High School	Warragul	35				
3	Payne, A. E. T.	"Yarra View," Lilydale	80	7	Harris, J. W.	"Rowena," Clyde	72
4	Dennis, Mrs. A. A.	Frankston	14	8	School of Horticulture	Burnley	8
5	Lady Talbot Milk Supply Company	Cranbourne	418				

By A. W. Jessep, M.Agr.Sc., B.Sc., Dip. Ed. Principal, School of Horticulture, Burnley

The Flower Garden.

MOST gardens are practically devoid of flowers during the winter months but, if sufficient thought and care are given, a colourful garden is an all the year round possibility. The home gardener cannot resist staging a full dress rehearsal in the spring and autumn, with the natural result that in the summer and winter the garden has rather a barren appearance. Where water is scarce, it may be difficult to grow summer flowering plants, but if there is a reasonable supply, it is not a difficult matter.

True, seedlings and mature plants cannot be grown in the same bed at the same time, but the garden planting should be arranged to have a rotation of planting instead of filling up all the area to give a spring show and then removing, and replenishing for an autumn one. This practice is probably easier, but it does not give flowers when they are usually much sought after. Annuals, which will withstand our winter conditions, may be grown in Victoria.

To illustrate how blooms may be obtained throughout the year, a brief list of easily grown plants is appended. In addition, the time-

FLOWERING PERIODS FROM JANUARY TO DECEMBER.

Name of Plant.	Dates of Planting.			Flowering Period.
	Seeds.	Cuttings or Seedlings.	Corms, Bulbs, Tubers, &c.	
Antirrhinums	September	October		January and February
Asters	"	"		" "
Gladioli			October	" "
Carnations		November		" "
Celosia	October			" "
Petunias	"	November		" "
Phlox Drummondi	"			" "

FLOWERING PERIODS FROM JANUARY TO DECEMBER.—*continued.*

Name of Plant.	Dates of Planting.			Flowering Period.
	Seeds.	Cuttings or Seedlings.	Corms, Bulbs, Tubers, &c.	
Dahlias	..	October	December	March and April
Zinnias	October	November	..	,, ,,
Marigolds	,,	,,	..	,, ,,
Petunias	,,	,,	..	,, ,,
Bonfire Salvia	,,	December	..	,, ,,
Gladioli	..	..	January	,, ,,
Chrysanthemums	..	August	..	,, ,,
Phlox Drummondi	October	..	..	,, ,,
Delphiniums	September	November	September	,, ,,
Chrysanthemums	..	October	..	May
Gladioli	..	..	February	,,
Sweet Peas (winter flowering)	February	..	..	,,
Marigolds	November	December	..	,,
Petunias	,,	,,	..	,,
Zinnias	,,	,,	..	,,
Phlox Drummondi	October	..	..	,,
Sweet Peas (winter flowering)	February	..	..	June
Chrysanthemums (winter flowering)	..	October	..	,,
Poppies, Iceland	January	March	..	,,
Marigolds (late)	December	January	..	,,
Stocks, winter	,,	,,	..	,,
Pansies	March	May	..	July and August
Poppies, Iceland	January	March	..	,, ,,
Sweet Peas (winter flowering)	February	,,	..	,, ,,
Calendula	,,	April	..	,, ,,
Ranunculus	September	..	March	,, ,,
Anemones	,,	..	,,	,, ,,
Ranunculus	September	..	April	September
Anemones	,,	..	,,	,,
Cinerarias (sheltered position)	March	June	..	,,
Pansies	,,	May	..	,,
Violets	..	..	April	,,
Stocks, winter	March	April	..	,,
Calendulas	,,	May	..	,,
Iris	..	..	January	,,
Daffodils, &c.	..	..	March	,,
Delphiniums	..	..	August	October and November
Cornflowers	August	..	..	,, ,,
Dianthus	August	September	..	,, ,,
Nemesias	August	..	..	,, ,,
Iris	..	..	January	,, ,,
Stocks	July	October	..	,, ,,
Lupins	August	,,	..	,, ,,
Antirrhinums	,,	September	..	,, ,,
Sweet Peas (spring flowering)	July	..	..	,, ,,
Lupins	August	October	..	December
Delphiniums	September	,,	..	,,
Carnations	..	April	..	,,
Gladioli	..	..	September	,,
Antirrhinum	August	September	..	,,
Sweet Peas (late)	September	..	..	,,
Lilies	..	..	May	,,
Stocks	September	October	..	,,

of planting for seeds and seedlings, and the approximate dates of flowering, are shown also. If seedlings are used instead of seeds, they may be planted about four to six weeks later than the time shown for seeds. The dates selected are for southern Victoria. Although growth is slow during the cold months, the blooms last much longer than in the warmer weather.

The accompanying list does not include such easily grown plants as roses, hydrangeas, and other flowering shrubs, but it is sufficient from which to choose for producing a sequence of blooms throughout the year.

For winter flowers, commence sowing the seed now, e.g., Iceland poppies, winter sweet peas, pansies, violas, calendulas, &c.

Vegetables.

To obtain the maximum benefit from vegetable growing, it is essential to work out a scheme so that the plants will be ready for culinary purposes when most desired. To have a succession of vegetables, it is necessary to make several plantings. There is a mean growing period for each species, but varieties have been produced which are adapted for earliness or lateness, and it is imperative to obtain the correct variety for the planting, e.g., in cabbages, an early variety is Enfield Market, which should be sown in February to ripen in June. Another variety, Succession, is sown at the same time, but does not ripen until July or August. Early cabbages take about three and a half to four months, from the time of sowing the seed, until ready for use, while the later types require about five to six months. Seed of winter cabbages should be sown now.

To have a succession of beans, monthly sowings should be made from October until February. By this means, beans should be available from early December until the frosts destroy the plants about June.

Sowings of carrots, parsnips, cauliflowers, and red beet should be made this month. It is not too late to plant out well-grown tomato plants.

The two important operations during summer months—watering and hoeing—should be carefully studied. Intelligent hoeing will save a good deal of watering.

The Orchard

By J. L. Provan, B.Agr.Sc., Horticultural Research Officer.

The harvesting of the late apricot varieties—Tilton, Mansfield, Alsace, and Rose de Vaucluse may extend into the first week of January and so conclude the crop for this season. The early European plum, Angelina Burdett, will be harvested during January, and early apples, mid-season peaches, and early nectarines (Early Rivers and Goldmine) will also ripen. Of the apples, Lord Nelson, William's Favorite and Emperor Alexander, and Gravenstein from the northern districts, will be marketed. The canning peach season commences with the varieties Tuscan and Levis, and this month, the choicest varieties of dessert peaches—Zerbe's, Pump's, Ireland's, Noonan's, and Wiggins—will be picked. Many varieties of Japanese plums will also mature in January.

Robe de Sergeant prune trees in the Goulburn Valley.

Peaches and plums may be sprayed up to the day before picking, with ammonium polysulphide, one gallon in 80 gallons of water, plus 3 lb. of soft soap, as a protection against brown rot.

The codling moth is not so plentiful during January, and spraying may be postponed until

February, when the summer brood appears. This season, the value of lure pots has been most marked, and to date, by this means, two main flights have been observed.

Red scale of citrus trees spreads rapidly during the hot weather, and an early attack on this pest will ensure a cleaner crop in the winter. For heavy infestations, night fumigation with hydro-cyanic acid gas, in the form of Cyanogas, Calcid Briquettes, or Liquid HCN, is recommended. Where the infestation is lighter and the spraying equipment is efficient, thorough spraying with white oil emulsion, one gallon to 40 gallons of water, will give good control. An interesting article on Citrus Red Scale, appeared in the August, 1937, number of this *Journal*, and a free bulletin, entitled "Fumigation of Citrus Trees" is available on application to the Director, Department of Agriculture, Melbourne, C.2.

During January, particular attention should be given to irrigation. Applications of water should be made so that an even distribution occurs along the furrow as well as in depth. Too frequently the headlands and the footlands receive excessive amounts. This is not only wasteful but may also be detrimental to the trees' health.

Orders for seed, to sow green cover-crops in alternate lands, should be made early. Field peas, tick beans, barley, and vetches are popular types of cover-crops, and the rate of sowing varies from one to one and a half bushels per acre.

Many plum, cherry and pear trees, in the smaller orchards and gardens, have been affected by a small shining, black slug, with a large head, which eats the surface of the leaves and causes them to turn brown as if scorched by fire. This slug is known as the pear and cherry slug, and often causes a lot of damage to foliage. It can be easily controlled by spraying with lead arsenate paste, 5 lb. in 80 gallons of water, i.e., 1 oz. per gallon.

Growers who desire information concerning fruit trees are invited to write to the Director of Agriculture.

Viticultural Notes

By D. G. Quinn, Viticulturist

"Rolling on" and Oidium.

"Rolling on" and Oidium are worthy of review at the present time, as they occupy much time in the vineyard during mid-summer. Recent tests have proved that "tipping" and "topping" in lieu of "rolling on" have a depressing effect on the growth of the vine, and the ripening of the fruit. Further it has long been known that the sugar finally found in the grape is due to the elaboration of organic compounds by the leaves, hence the suppression of foliage can only have such an effect.

Where the vines grow vigorously, however, it is often difficult to accommodate the large bulk of foliage on the ordinary trellis. If the canes are gathered together like the fibres in a rope and then rolled on the wire, so many leaves are buried from the direct sunlight, and therefore rendered inactive, that the effect is not particularly different from topping, except that the prospects for disease development in the massed foliage are greatly enhanced.

The specifications for the ordinary sultana trellis were evolved when the average grower expected about 3 tons of green fruit per acre. To-day, owing to improved cultural methods, many growers regularly produce more than double this quantity, and in many cases trellises are too low to effectively carry the extra foliage which accompanies heavy production, and the massed growth increases humidity, making conditions more favorable for the development of disease.

Oidium.

Years ago the island of Madeira was famous for viticulture. To-day its production is negligible, because its climate is so favorable to the fungus Oidium, that the known specifics will not effectively control it. Preventive measures were also regularly included in the annual routine, when viticulture was flourishing in the wetter districts of Victoria, but to-day most vignerons in the drier areas have largely forgotten the trouble.

This disease seems to disappear from districts for long intervals, then reappear unnoticed, and, possibly favoured by mild weather and the presence of numerous spores, it suddenly becomes an acute problem for several seasons. Of late, it has been affecting some of the Murray and the wetter wine-making areas very seriously, in fact doing more harm than all the other diseases considered collectively.

Growers are very apt to report that the standard treatment for oidium control is ineffective, but in most cases, it can be noted that they have started sulphuring too late. In situations where

oidium appears practically every year it is a mistake to await the appearance of the disease. It works slowly and unostentatiously at low temperatures, and the first sulphuring should be given when the shoots are about 9 inches long, and at this stage 6 to 10 lb. of sulphur per acre will be sufficient.

As the day temperatures rise to about 70° F. the disease grows actively. This activity increases progressively as the seasonal daily temperatures rise to 95° F. Temperatures above 100° F. accompanied by a dry atmosphere gradually destroy the fungus without the aid of sulphur. Where sulphur is used as a preventive, about three sulphurings at intervals of three weeks are given in the spring, using about 6 lb., 20 lb., and 30 to 60 lb. per acre, respectively.

The fungicidal fumes of sulphur are not rapid in action during cold weather, but at a temperature of 77 to 80° F. these fumes will destroy the fungus in four to five days. In occasional seasons more than three sulphurings are necessary. Lime-sulphur is rapid in action during cold weather, but dangerous during warm weather. Colloidal sulphur is probably valuable, but observations to date have shown that one spraying combined with Bordeaux in mid-November allowed a very heavy growth of oidium to be observed one month later.

Mortality of Horses from Poison Lobelia

IN several cases recently, deaths of horses have been traced to a weed commonly known as Poison Lobelia, but more correctly as the Swamp Isotome. This weed is a creeping perennial 2 to 3 inches high with toothed oval leaves about ¼ inch long and shortly stalked on the stem. The flowers—white through a range to blue and purple—are also shortly stalked on the main stem and the seeds are smooth and oval.

The weed is found in many parts of Victoria, but particularly in the north-eastern and northern districts. Its natural habitat is swamp country and of recent years it has invaded the irrigation areas. The poisonous properties of Swamp Isotome affect the heart, and sudden death of horses in these areas should be regarded as suspicious of poisoning by this weed.

Reports investigated by officers of the Department reveal that in most cases a horse will collapse and die shortly after being yoked in a team, while cases have been known where horses at grazing, on being startled, may commence to gallop across a paddock only to collapse and die in a very short time.

Where any mortality under circumstances as described occurs, it is advised that the remaining horses be kept from any form of exercise for at least a week, and of course investigations into the likelihood of this weed being present should be made.

Feeding Farm Horses

ONE of the most frequent causes of trouble in the management of horses on farms is due to the fact that insufficient attention is paid to their feeding. Lack of tone in the horse's system due to indigestion reduces the efficiency of horse teams.

Among the common errors are :—Feeding when the horses are fatigued or in an exhausted state, allowing too long an interval between feeds, allowing insufficient time for the morning and midday meals and giving too bulky a ration and consequently an ill-balanced one.

Overfeeding horses on non-working periods, such as week-ends, with the idea of making them fitter for their work on the following day, is another common error as are feeding fodder of low quality and of doubtful soundness, and placing food before horses after work before they have quenched their thirst.

Hot and tired horses, although they may be hungry, are unable to cope with the digestion of food until they have taken water. Possibly the best arrangement is for water to be available whenever it is desired.

Investigations on the Storage, Ripening and Respiration of Pears

*By *G. B. Tindale, B.Agr.Sc., †S. A. Trout, M.Sc., Ph.D., and F. E. Huelin, B.Sc., Ph.D.*

THE experiments to be described in this paper have been in progress over a number of years, and were initiated by the Victorian Department of Agriculture. In 1932, the scope of the work was greatly extended by the formation of an Advisory Committee on Fruit Storage Investigations, comprising officers of the Council for Scientific and Industrial Research and the Victorian Department of Agriculture. Under the direction of this Committee, the major portion of the work has been conducted at the Government Cool Stores, Melbourne, but certain chemical determinations were made at the Biochemistry School at the University of Melbourne.

When the experiments were initiated, there was only a small export trade of pears from Victoria, for, although good prices were obtained overseas for pears landed in good condition, the frequency with which they arrived affected with disorders caused a lack of confidence to exporters. It was on this account that the investigations were commenced. Gradually, knowledge was acquired regarding the nature and prevention of pear disorders, and Departmental regulations were then introduced in Victoria controlling the conditions under which pears were to be handled for export. Growers and shippers are now confident of being able to land most varieties overseas in good condition, and this confidence coupled with profitable prices has led to a greatly increased export trade, with Victoria as the main exporting State in the Commonwealth.

The early experiments were conducted mainly with the Williams Bon Chrétien (W.B.C.) variety on account of its being particularly susceptible to storage disorders, but later the experiments were extended to embrace the main export varieties. The W.B.C. variety was obtained from both the Doncaster and Shepparton districts, but the other varieties were selected from the former district only.

Although pears thrive in each district, there is a big difference in the climatic and cultural conditions of the two places. Doncaster developed as a fruit-growing centre mainly because of its proximity to the city of Melbourne. The land is undulating, usually rather poor, requires liberal manuring, and the trees are watered sparingly from local catchments or the metropolitan water supply.

Shepparton is an established irrigation district over 100 miles north of Melbourne, and is considerably warmer and drier than Doncaster. The trees are heavily watered from the Goulburn Irrigation Scheme. The area is flat, and the soil and climate seem ideal for growing pears, the trees being exceptionally prolific and the pears being very bright (free from russet), as it is not necessary to spray as frequently to control black spot as in the moister Doncaster district.

In Shepparton is situated the largest cannery in the Southern Hemisphere, and the district was planted originally with only one variety of pear, the W.B.C., together with peaches and apricots.

* Cool Storage Research Officer, Victorian Department of Agriculture. † An Officer of the Section of Food Preservation and Transport, Council for Scientific and Industrial Research.

At first there was little if any cool storage accommodation available in the district, and when it was required to cool store pears for canning later, or when on occasions export was attempted, the pears had to be picked and packed and then railed to Melbourne for cool storage during the height of the summer, when temperatures frequently exceeded 100° F. Shepparton pears treated in this way would not keep nearly as well as the Doncaster pears cool stored promptly after picking, and in consequence the trade accepted the idea that pears grown under irrigation would not keep. However, it was soon demonstrated, and accepted by the trade, that lack of local, and therefore prompt, cooling facilities and not heavy irrigation in itself was responsible for the poor keeping quality of the Shepparton pears. Since then very large cool stores have been erected by the canneries for the storing of pears for canning as required.

The presence of the cool stores in Shepparton has made possible the development of an export trade in fresh pears from that centre, for it permits of prompt cooling after picking. This trade is now rapidly expanding, leading to the planting up of new areas of the best export varieties.

Object of Investigations.

The object of the investigations has been to determine the effect of temperature and picking maturity on the storage life of various varieties of pears, and the factors responsible for the development of the disorders of mealiness, core breakdown, and scald. This involved measurements of the daily output of carbon dioxide of the pears and of the various physical and chemical changes which occur during storage and ripening.

Experimental Procedure.

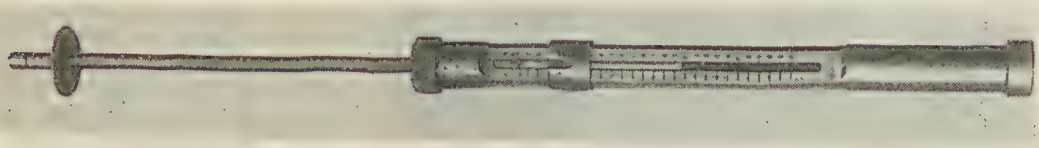
In general, three pickings of each variety were made from selected trees at Doncaster, and of one variety only, the W.B.C., from Shepparton. In order to determine the optimum picking time, the pickings were arranged usually at ten-day intervals to cover a period extending both slightly before and slightly after the "commercial" picking period for the district. The "commercial" picking period has gradually evolved, as the experience of growers indicated that picking at that period gave them the best storage results.

In making three pickings at such intervals, the largest pears are picked first, irrespective of their position on the tree. By the time the subsequent pickings are made, the remaining pears increase very appreciably in size and approximate in size to that of the earlier picks. By picking over a tree three times, there is the added commercial advantage of spreading the work of picking and packing over a longer period.

No attempt was made to pick the pears to any particular size, for this is scarcely practicable. In actual practice, picking as above, it is found that

Table I.—Dates of Picking, and Colour and Penetrometer Pressure at Picking Time.

Variety.	District.	Picking.	Average Date of Picking.	Colour (over Four Years).	Range of Pressures (over Four Years).	Pressures During One Year.
Williams	Doncaster	First	January 29	1	23	23
	Doncaster	Second	February 6	1¼	18–23	22
	Doncaster	Third	February 14	1½	17–22	22
	Shepparton	..	January 29	1	21–23	21
Howell	Doncaster	First	February 2	1	21–23	21
	Doncaster	Second	February 15	1¼	19–21	21
	Doncaster	Third	February 27	1½	15–21	21
Bosc	Doncaster	First	February 19	<1	18	18
	Doncaster	Second	March 3	1	15–18	18
	Doncaster	Third	March 17	1¼	14–18	18
Packham	Doncaster	First	February 19	<1	17–19	19
	Doncaster	Second	February 26	1	14–19	19
	Doncaster	Third	March 9	1¼	12–19	19
Winter Cole	Doncaster	First	February 25	<1	14–16	16
	Doncaster	Second	March 10	1	13–16	16
	Doncaster	Third	March 24	1	11–16	16
Josephine	Doncaster	First	March 3	1	13–17	17
	Doncaster	Second	March 17	1¼	14–17	17
	Doncaster	Third	March 31	1½	12–17	17
Winter Nelis	Doncaster	First	March 6	<1	18	18
	Doncaster	Second	March 20	1	18	18
	Doncaster	Third	April 9	1¼	17	17



The penetrometer, used to measure the resistance of the flesh of the pear.

most of the pears range in size from 2½ inches to 2¾ inches. Where the crop is light the individual fruits tend to be large. In this case, a greater percentage of the crop would be picked at the first picking, and most of the pears might be of the 2¾-inch size, and at subsequent pickings would have grown to over 3 inches. While it has been found that pears over 3 inches will keep just as long as small pears of similar maturity, very large pears are not popular commercially. On the other hand, should the crop be a particularly heavy one, and should the season be dry, pears of each picking might scarcely exceed 2¼ inches. This is the minimum size permitted by Departmental regulations governing the export of Extra Fancy Pears.

The pears were picked from Doncaster during the morning and placed in cool store on the same day, while those picked at Shepparton were railed to Melbourne during the evening and placed in store the following morning.

Colour, Pressure and Chemical Composition at Picking.

From time to time the colour of the skin, the resistance of the flesh to penetration, the colour of the pips and various chemical constituents have been advocated as guides for the optimum picking time.

The times of picking, colour and pressure measurements by the penetrometer at picking time are recorded in Table I.

Optimum Picking Time.

Of the various criteria none is as simple or as generally reliable as the time of picking, for the optimum time of picking does not vary by more than one week from year to year. At the optimum picking time pears are easily picked, breaking away from the spur when a gentle pull is exerted, or when the pear is bent backwards. When this time has passed, the early maturing varieties particularly are inclined to fall from the tree. When pears are picked before the optimum picking time they are rather difficult to pick, hanging so tightly to the spur, that, on picking, the spur is frequently broken away from the tree.

The colour of the pears at picking time is dealt with in detail later, but it is sufficient to state at this juncture that pears picked before the optimum picking time are very dark green in colour and gradually change to a paler green at the optimum picking time. When this time has passed the ground colour gradually develops a tinge of yellow. The optimum picking time for each variety extends over a period of approximately a fortnight.

Pears picked too early fail to develop good quality on ripening after storage. Pears picked too late are of excellent quality on ripening, but have a shorter storage life. Pears picked at the optimum time combine reasonably long storage life with good quality on ripening. The optimum picking date for each variety is within one week of the date of the second picking in Table I.

Colour at Picking Time.

The ground colour of the pears was determined by comparison of the fruit with standard colour plates in Maerz and Paul's Dictionary of Colour, under conditions of standard illumination. For russeted varieties such as the Bosc, Winter Cole and Winter Nelis the upper skin was scratched away by means of a sharp knife, and the colour just beneath the skin was determined.

At picking time the colour of the first maturity of all varieties was approximately the same as Plate 1 on the colour chart which accompanies this article, while that of the third maturity was between Plates 1 and 2. The colour of very immature undersized pears was not appreciably greener than Plate 1. Thus the change in colour during the picking period is so slight that the use of a colour chart as a guide to picking is of little commercial value. There is little risk attached to picking pears too early provided they are not undersized, but one should avoid picking pears with a tinge of yellow.

Hardness of Flesh at Picking.

Allen (1) and Hartman, Reimer and Norris (5) in America have given great attention to standards for picking, and have advocated the use of a penetrometer, an instrument which records the

TABLE II.—SUGAR AND ACID CONTENT OF W.B.C. PEARS FROM DONCASTER AT PICKING TIME.

Date of Picking.	Size.	Reducing Sugar.	Cane Sugar.	Total Sugar.	Acid.
		%	%	%	%
20th February, 1933	..	7·57	0·66	8·23	0·18
24th January, 1934	2¼	6·31	0·22	6·53	..
24th January, 1934	2½	6·5	0·2	6·7	..
24th January, 1934	2¾	6·65	0·43	7·08	..
24th January, 1934	Mean	6·49	0·28	6·77	..
31st January, 1934	2¼	6·34	0·46	6·8	..
31st January, 1934	2½	6·44	0·48	6·92	..
31st January, 1934	2¾	6·34	0·47	6·81	..
31st January, 1934	Mean	6·37	0·47	6·84	..
7th February, 1934	2¼	6·75	1·04	7·79	..
7th February, 1934	2½	6·95	1·07	8·02	..
7th February, 1934	2¾	6·58	1·06	7·64	..
7th February, 1934	Mean	6·76	1·06	7·82	..
4th February, 1935	..	6·56	1·14	7·7	0·154
12th February 1935	..	6·39	1·16	7·55	0·122
18th February, 1935	..	6·69	2·08	7·82	0·092
29th January, 1936	..	..	..	..	0·262
10th February, 1936	..	..	..	..	0·235
18th February, 1936	..	..	..	..	0·261
8th Februray, 1937	..	..	..	..	0·185

resistance of the flesh of the pear to the penetration of a plunger. The plunger is a cylindrical steel rod of $\frac{5}{16}$-in. diameter, which is forced to a depth of $\frac{5}{16}$-in. into the flesh of the pear after the skin has been removed, and the pressure required to penetrate the pear is recorded by means of a spring which is compressed as the plunger is forced into the pear.

In Table I. the pressure required to force the standard plunger the required depth is recorded for all varieties and for the three picking maturities. It will be observed that there is a greater variation from year to year in any one picking than there is between different maturities in the same year. In these circumstances it is scarcely feasible to advocate the use of pressure as an accurate guide to picking maturity.

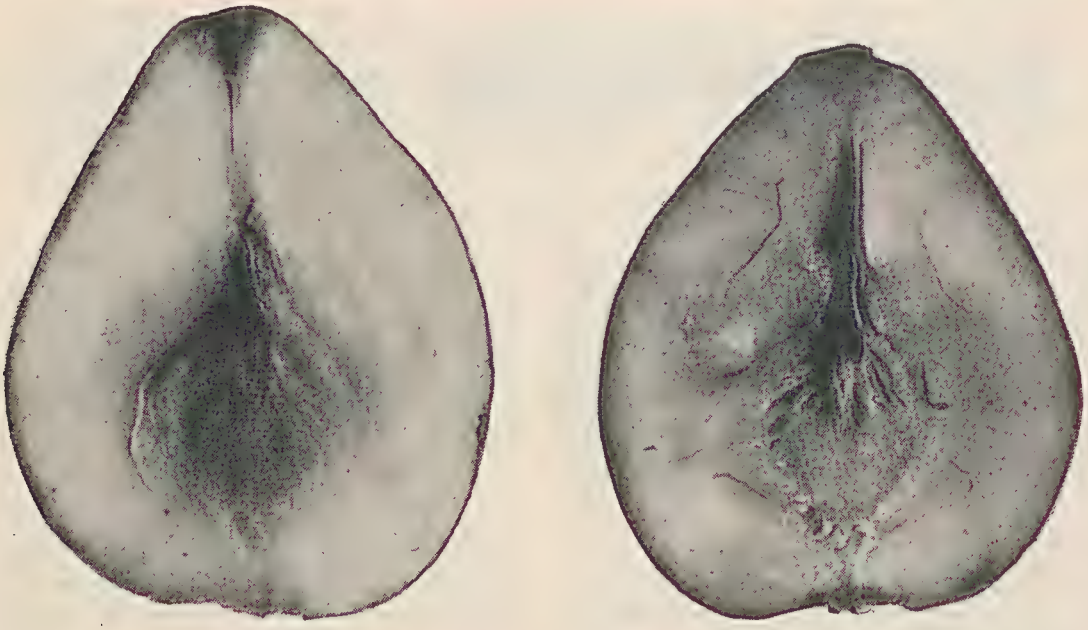
CHEMICAL COMPOSITION AT PICKING.

In Table II. are recorded the sugar and acid content of W.B.C. pears from Doncaster at picking time.

A unit of ten pears was adopted in all the chemical analysis. The pears were peeled and cored, and the flesh cut into small pieces, which were thoroughly mixed. A weighed sample was boiled with alcohol, and the alcoholic extract filtered off. The residue was then extracted with boiling alcohol for four hours in a modified Soxhlet apparatus. The combined alcoholic extracts were evaporated to a small bulk, and then made up to a definite volume with distilled water. An aliquot part was cleared with basic lead acetate, de-leaded with potassium oxalate, and made up to a definite volume with distilled water. Reducing sugars were determined in the cleared extract by the method of Bertrand. Total sugar was determined by the method of Bertrand after boiling with 10 per cent. citric acid for 20 minutes. The results are expressed in terms of invert sugar.

In the years 1933–35 the acidity was determined by titrating an aliquot part of the uncleared extract with 0·1 N sodium hydroxide solution, using phenolphthalein as indicator. In 1936–37 determinations of acidity were made directly on the juice. The results are expressed in terms of anhydrous malic acid as per cent. of the flesh or juice.

The results from Table II. show a very definite increase in cane sugar content as the fruit reaches full maturity on the tree, and this is sometimes accompanied by an increase in reducing sugar. Unfortunately the difference between two seasons is quite as great as the increase in sugar content



Core breakdown as typical of over-stored pears—left, with core only affected; right, with both core and flesh affected.

during the commercial picking period, and the sugar content therefore is of very doubtful value as a guide to maturity. The effect of size within any particular picking is practically negligible.

The figures for acidity need to be interpreted with caution, as two different methods of estimation have been used. There is no consistent fall during the picking period, and the seasonal variation makes the acidity of even less value than the sugar content as a guide to maturity. The acid content of pears is also very low compared with many other fruits.

The samples were also tested for starch with an iodine solution, but no relation to maturity was found. Very little starch was present in most cases.

Length of Storage Life and Physiological Disorders of Cool Storage.

When a pear is picked at the optimum stage of maturity it is hard and green. During cool storage at the usual temperature of 32° F., it will soften slightly and gradually change colour, but will not develop aroma, flavour and juice, the characteristics of normal ripening. Ripening will only take place at temperatures which are usually much higher than those used for cool storage purposes. The optimum temperatures for ripening will be discussed in detail later, but it is sufficient

Showing cavities in the core, as frequently seen in over-stored Bosc pears.

to mention here that the W.B.C. and possibly the Bosc varieties will not ripen normally below a temperature of 65° F. The other varieties will ripen at 45° F., and above.

In the experiments, samples of pears of all varieties and maturities were removed from storage at temperatures from 30° to 37° F. to a ripening room maintained at 65° F., at which temperature all varieties ripened satisfactorily. It was found that only a certain number of removals (varying with variety and storage temperature) ripened at 65° F. with the full development of aroma, flavour, and juice. Subsequent removals lacked both flavour and juice at 65° F. and then developed physiological disorders of mealiness, core breakdown and scald.

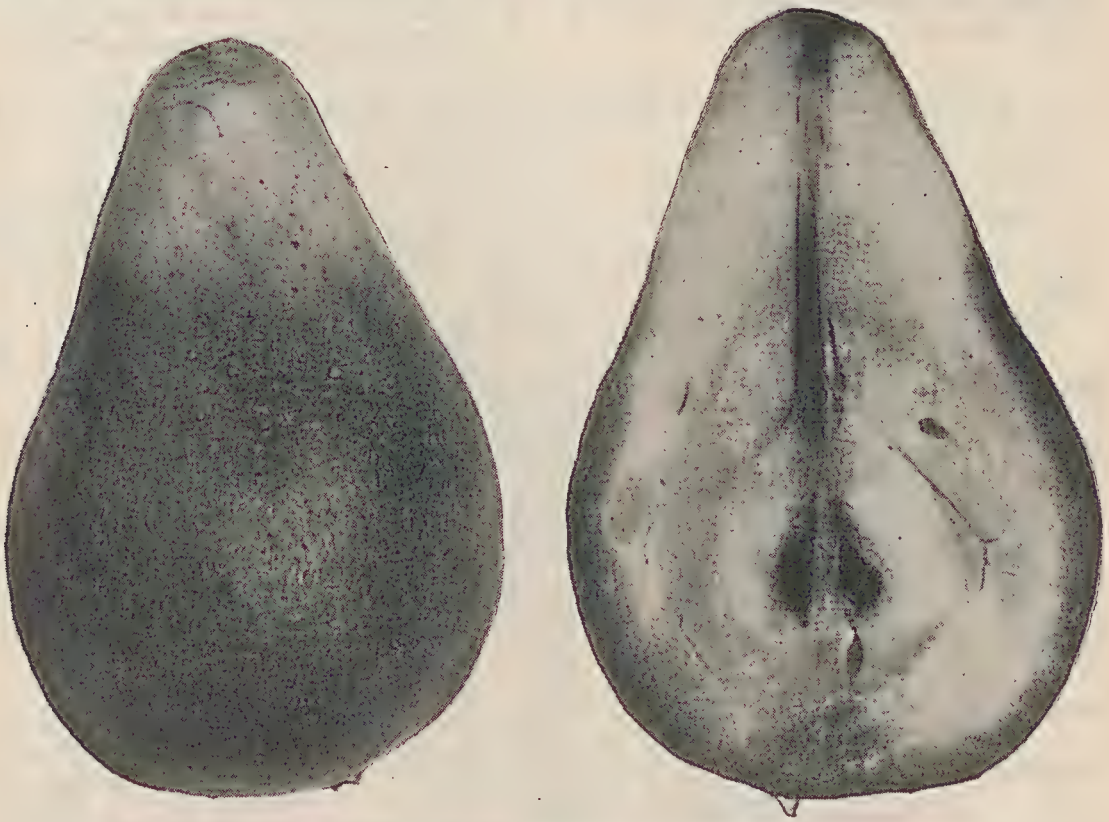
Mealiness is a condition of the pear in which both flavour and juice are lacking and the flesh is dry and easily broken by hand pressure into small fragments without exudation of juice.

Core breakdown, sometimes called core collapse, internal browning, internal breakdown, is characterized by a softening and darkening of the tissues in the region of the core with the core easily separating from the flesh. The disorder may be closely confined to the core but may extend to the surrounding portions of the flesh. In the incipient stages, the flesh is fairly soft, but in the later stages remains hard and discoloured with a disagreeable odour and taste. In the Bosc variety, cavities frequently appear in the core, and this may easily be mistaken for brown heart.

Scald is characterized by a discolouration of the skin and later of the flesh. The flesh is hard and has a disagreeable odour and taste. Scald is sometimes difficult to detect on russeted varieties.

The fact that these disorders eventually develop in all varieties definitely indicates that they are merely normal changes associated with the prolonged storage of pears. In this respect, they are different from such disorders as Jonathan scald in apples, which is spasmodic in its incidence and occurs during the early stages of storage.

The maximum length of time pears can be kept in cool store and still ripen normally on removal to a ripening temperature is termed the



Pears affected with scald—left, external appearance; right, internal appearance.

"cool storage life." The length of storage life varies appreciably with variety and is dependent on the storage temperature, the maturity of the fruit at picking time and the interval between the time of picking and placing in store.

The length of storage life of several varieties at various storage temperatures was determined by removing samples from these temperatures to 65° F. and noting the time when the fruit failed to ripen normally. The W.B.C. pear, for instance, ripened at 65° F. with full development of flavour and juice when removed from 32° F. after 12 weeks, but when removed after 14 weeks was lacking in flavour and juice. Samples removed after 16 weeks at 32° F. developed core breakdown. Thus the length of storage life of the W.B.C. pear at 32° F. was 12 weeks. In the W.B.C. variety the interval between the removal which ripened normally and that which developed core breakdown was only one month, but in the other varieties there was a fairly long period during which slightly over-stored pears ripened with fair flavour and juice. The quality of these pears, however, was definitely inferior to that of the excellently flavoured juicy product of the earlier removals.

The marketing of these slightly over-stored pears should be avoided, because buyers being disappointed with the quality are likely to condemn this variety for its poor flavour and juice. It is difficult to tell from the appearance when the pear is slightly over-stored, but one can be guided to a large extent by the figures for the length of storage life obtained from experiments over several seasons.

Effect of Temperature on Storage Life.

The length of storage life of the main varieties of pears at various temperatures is recorded in Table III.

The longest storage life was obtained at the lowest storage temperature, i.e., 30° F., in the case of the W.B.C. variety. As there is a certain amount of risk attached to the use of a temperature of 30° F. owing to freezing injury, the best results would be obtained by using a storage temperature of 30° to 32° F.

More records on the effect of temperature on the length of storage life have been obtained with the W.B.C. than with the other varieties. Over the range 30° to 45° F. the storage life of the W.B.C. pear is decreased by one-fifth for a rise in

TABLE III.—THE EFFECT OF TEMPERATURE AND THE TIME OF PICKING ON THE STORAGE LIFE OF PEARS.

Variety.	District.	Picking.	Date of Picking.	Length of Storage Life (Months) at—					
				45°.F.	37°.F.	36°.F.	34°.F.	32°.F.	30°.F.
W.B.C. ..	Shepparton ..	.. ..	January 29 ..	..	1¾	2	..	3½	..
	Doncaster ..	First ..	January 29 ..	..	1¾	..	..	3	..
	Doncaster ..	Second ..	February 6 ..	½	1½	1¾	2½	2¾	3½
	Doncaster ..	Third ..	February 14 ..	..	1¼	..	..	2½	..
Howell ..	Doncaster ..	First ..	February 2 ..	..	2½	..	..	4	..
	Doncaster ..	Second ..	February 15 ..	..	2	..	..	3½	..
	Doncaster ..	Third ..	February 27 ..	..	1½	..	..	3	..
Bosc	Doncaster ..	First ..	February 19 ..	..	2½	..	..	4	..
	Doncaster ..	Second ..	March 3 ..	..	2	..	..	3½	..
	Doncaster ..	Third ..	March 17 ..	..	1½	..	..	3	..
Comice ..	Doncaster ..	.. ..	February 23 ..	..	..	..	..	4	..
Madame Cole ..	Doncaster ..	.. ..	March 9 ..	..	..	..	..	4½	..
Anjou	Doncaster ..	.. ..	February 16 ..	..	..	..	..	4½	..
Packham ..	Doncaster ..	First ..	February 19 ..	..	3½	..	..	5	..
	Doncaster ..	Second ..	February 26 ..	..	3	..	..	4½	..
	Doncaster ..	Third ..	March 9 ..	..	2½	..	..	4	..
Winter Cole ..	Doncaster ..	First ..	February 25 ..	..	4½	..	..	6	..
	Doncaster ..	Second ..	March 10 ..	..	4	..	..	5½	..
	Doncaster ..	Third ..	March 24 ..	..	3½	..	..	5	..
Josephine ..	Doncaster ..	First ..	March 3 ..	..	4½	..	..	6	..
	Doncaster ..	Second ..	March 17 ..	..	4	..	..	5½	..
	Doncaster ..	Third ..	March 31 ..	..	3½	..	..	5	..
Winter Nelis ..	Doncaster ..	First ..	March 6 ..	..	5	..	..	6½	..
	Doncaster ..	Second ..	March 20 ..	..	4½	..	..	6	..
	Doncaster ..	Third ..	April 9 ..	..	4	..	..	5½	..

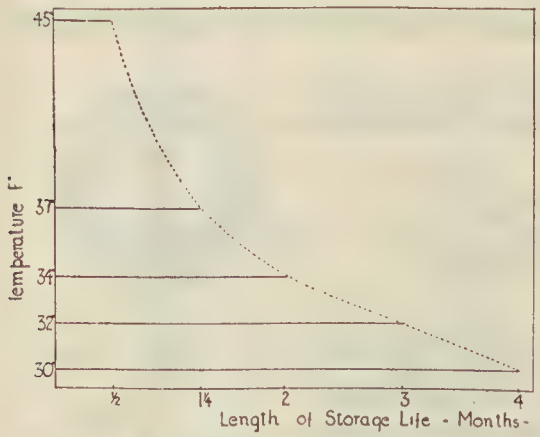


Fig. 1.—The effect of temperature on the length of storage life of W.B.C. pears.

temperature of 2° F. The storage life of the other varieties over the range 32° to 37° F. is decreased by one-fifth for a rise in temperature of 3° F.

The effect of temperature on the storage life of the W.B.C. pear is shown graphically in Fig. 1.

Effect of Maturity on Storage Life.

From Table III. it will be observed that three pickings of most varieties were made extending over a period of approximately four weeks. In spite of this difference in picking maturity it was found with each variety, except the W.B.C., that the storage life of each picking terminated at the same time, the actual date being dependent on the variety. Thus the actual length of the storage life of the third picking was approximately four weeks less than that of the first picking. The flavour on ripening of the last picking, however, was excellent, but that of the first picking was only fair, and that of the second picking very fair.

The storage life of the third picking of the W.B.C. pear at 32° F. was terminated one week before that of the earlier pickings. In this variety the period between removals which ripened normally and those which developed core breakdown was relatively short, and it was possible to determine the storage life with greater accuracy than with the longer keeping varieties.

Effect of Size on Storage Life.

It is generally assumed that the larger fruits do not keep as well as the smaller. An experiment to determine the effect of size on the keeping properties of W.B.C. pears was carried out, three pickings being made from Doncaster and one from Shepparton. Each picking was graded into three sizes, viz., 2¼-in., 2½-in., and 2¾-in., and comparable lots were stored at 30°, 32°, 34°, and 36° F. Measurements of colour, pressure (Table IV.) and chemical composition (Table II.) at picking time indicated no differences between the three sizes of one maturity. The length of storage life of the three sizes was the same, and no differences in colour or pressure were observed either during storage or ripening. The shorter storage life, which has been attributed to the larger fruit, is probably due to this fruit usually being the more mature.

The colour and pressure at picking time and the length of storage life at 32° F. of the three sides of W.B.C. pears are recorded in Table IV.

TABLE IV.—THE COLOUR AND PENETROMETER PRESSURE AND THE LENGTH OF STORAGE LIFE OF THREE SIZES OF W.B.C. PEARS AT 32° F.

District.	Date of Picking.	Size.	Colour at Picking Time.	Pressure at Picking Time.	Length of Storage Life at 32° F.
		Inches.			Weeks.
Doncaster ..	25·1·34	2¼	1	23	14
	,,	2½	1	23	14
	,,	2¾	1	23	14
	31·1·34	2¼	1¼	21	13
	,,	2½	1¼	21	13
	,,	2¾	1¼	21	13
	7·2·34	2¼	1¼	20	11
	,,	2½	1½	20	11
	,,	2¾	1½	20	11
Shepparton ..	24·1·34	2¼	1	21	16
	,,	2½	1	21	16
	,,	2¾	1	21	16

Effect of Delayed Storage.

Experiments were conducted to determine the effect on the subsequent storage behaviour of delaying the cool storage of pears after picking. W.B.C. pears were picked at Shepparton, received at the experimental chambers the following day, and given various delayed storage treatments. The following results were obtained :—

Treatment.	Length of Storage Life. (Weeks.)
Stored immediately at 32° F.	13
Kept at 75° F. for 2 days then stored at 32° F.	5
Kept at 75° F. for 4 days then stored at 32° F.	1
Kept at 65° F. for 2 days then stored at 32° F.	6
Kept at 65° F. for 4 days then stored at 32° F.	4
Kept at 65° F. for 6 days then stored at 32° F.	1
Kept at 55° F. for 3 days then stored at 32° F.	6
Kept at 55° F. for 6 days then stored at 32° F.	4

TABLE V.—The Colour and Penetrometer Pressure at the Termination of the Storage Life of Pears at 32° and 37° F.

Variety.	Picking	Average Date of Picking over Several Years.	Colour at Picking over Several Years.	Pressure at Picking over Several Years.	Colour at End of Storage Life Showing Maximum and Minimum Values Obtained over Several Years at—		Pressure at End of Storage Life Showing Maximum and Minimum Values Obtained over Several Years at—		Fall in Pressure from Time of Picking to End of Storage Life at—	
					32° F.	37° F.	32° F.	37° F.	32° F.	37° F.
				lb.			lb.	lb.	lb.	lb.
W.B.C. (Doncaster) ..	First ..	29th January ..	1	23	3	2½	20	20	3	3
	Second ..	6th February ..	1¼	18–23	3½	3	15–20	15–20	3	3
	Third ..	14th February ..	1½	17–22	4	3½	14–19	14–19	3	3
W.B.C. (Shepparton) ..	.. ..	29th January ..	1	21–23	4–5	3–4	17–19	17–19	4	4
Howell	First ..	2nd February ..	1	21–23	3	3	16–18	16–18	5	5
	Second ..	15th February ..	1¼	19–21	3½	3½	14–16	14–16	5	5
	Third ..	27th February ..	1½	15–21	4	4	10–16	10–16	5	5
Bosc	First ..	19th February ..	<1	18	1½–3	3–5½	16	13	2	5
	Second ..	3rd March ..	1	15–18	2–3½	3½–5½	13–16	10–13	2	5
	Third ..	17th March ..	1¼	14–18	2½–4	4–5½	12–16	10–13	2	5
Packham	First ..	19th February ..	<1	17–19	2¼	3¼	14–16	10–11	3	7
	Second ..	26th February ..	1	14–19	2½	3½	11–16	7–9	3	7
	Third ..	9th March ..	1¼	12–19	2¾	3¾	10–16	6–8	3	8
Winter Cole	First ..	25th February ..	<1	14–16	2½–4	4	8–11	6–8	5	8
	Second ..	10th March ..	1	13–16	2½–4	4	7–11	5–8	5	8
	Third ..	24th March ..	1	11–16	2½–4	4	6–11	5–9	5	7
Josephine	First ..	3rd March ..	1	13–17	3½	4–5½	7–10	2–4	6	12
	Second ..	17th March ..	1¼	14–17	3½	4–5½	8–10	2–4	6	12
	Third ..	31st March ..	1½	12–17	3½	4–5½	7–10	2–4	6	12
Winter Nelis	First ..	6th March ..	<1	18	2–3	2½–4	14	3	4	15
	Second ..	20th March ..	1	18	2–3	2½–4	14	5	4	13
	Third ..	9th April ..	1¼	17	2–3	2½–4	13	4	4	13

Supplement to "Journal of Agriculture," Victoria.

COLOUR CHART FOR VICTORIAN PEARS

FOR PICKING

Pick when colour corresponds to Plate 1.

PLATE 1.

PLATE 2.

FOR OVERSEAS EXPORT

Pears should not be more coloured than Plate 2.

PLATE 3.

PLATE 4.

FOR STORAGE

Pears should be removed from Store at a colour between Plates 3 and 4.

PLATE 5.

PLATE 6.

Keep away from light when not in use.

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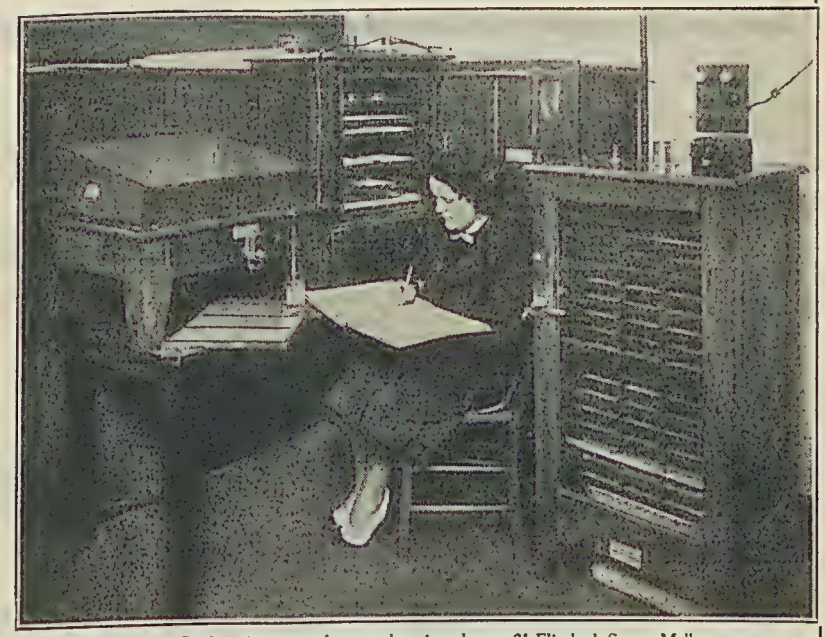

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From this table, it will be seen that an additional delay of two days at 65° F. after picking (in the immediately stored controls one day elapsed between picking and cooling) reduces the storage life of the W.B.C. pear to six weeks and makes overseas export impossible. Although no delayed storage experiments were carried out with the other varieties of pears, sufficient evidence has been obtained from other experiments to indicate that delaying the storage would considerably reduce the storage life. In these varieties, an additional delay of two days at 65° F. would probably reduce the storage life by one-third, compared with one-half for the W.B.C. variety.

It is therefore essential that pears should be cooled as soon as possible after picking, and this factor requires the closest attention in their export.

The temperatures used in this delayed storage experiment were chosen because they cover the range of temperatures which usually prevail during the pear-picking season, as the following records taken from the meteorological data (10) indicate :—

	Shepparton.			Doncaster.		
	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
Mean Max.	87·0	86·5	79·3	78·0	78·1	74·4
Mean Min.	59·0	59·4	54·5	56·7	57·2	54·7
Average ..	73·0	73·0	67·0	67·0	68·0	65·0

Physical and Chemical Changes During Storage.

When a pear is picked it is still a living organism taking in oxygen and liberating carbon dioxide produced by the combustion of the reserve materials of sugar, &c., which have been built up while the pear is growing on the tree. In addition to these chemical changes, certain physical changes in colour and firmness of the flesh occur during storage. All these changes were investigated and are discussed under separate headings.

Changes in Colour and Firmness of the Flesh.

While the range of colour of all pickings of all varieties at picking time was < 1 to 1½ (i.e., between Plates 1 and 2 on the colour chart), the colour at the termination of storage life varied from 1½ to 5½ according to the variety and maturity of fruit at picking time and the storage temperature. There was also considerable variation from year to year as indicated by the records in Table V.

That colour at the end of the storage life is also influenced by the conditions which prevail after picking is indicated by the results of the delayed storage experiments shown in Table VI. and Fig. 2.

Table VI.—The Colour and Penetrometer Pressure at the Termination of the Storage life of W.B.C. Pears after certain Delayed Storage Treatments.

Treatment.	Colour at end of life.	Pressure at end of life. (lb.)
Stored immediately at 32° F. ..	4½	17
Stored immediately at 37° F. ..	4	18
2 days at 75° F. then to 32° F. ...	5	3
4 days at 75° F. then to 32° F. ..	5½	1
2 days at 65° F. then to 32° F. ..	5	4
4 days at 65° F. then to 32° F. ..	5½	2
6 days at 65° F. then to 32° F. ..	5½	1
3 days to 55° F. then to 32° F. ..	5	5
6 days to 55° F. then to 32° F. ..	5½	2
9 days to 45° F. then to 32° F. ...	5	4
16 days to 45° F. then to 32° F. ..	5	2

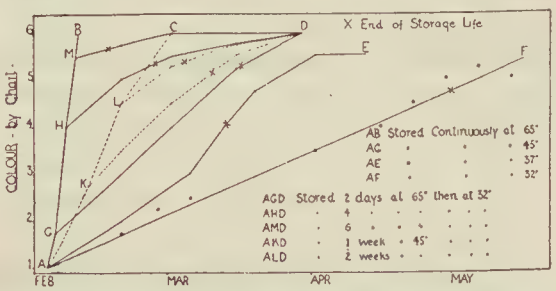


Fig. 2.—The effect of delayed storage treatments on the subsequent colouring of W.B.C. pears at 32° F.

It will be observed that the accelerated rate of colouring at the higher temperatures is still maintained when the delayed storage lots are removed to 32° F., and in consequence the storage life of the delayed lots is terminated at a higher colour than the controls. It is impossible, therefore, to state for all conditions the colour at which the storage life of W.B.C. pears is terminated. When they are stored at 32° F. as soon as possible after picking it would be advisable to remove them from store as soon as they reach a colour between Plates 3 and 4 on the chart, i.e., when the last trace of green is disappearing. It is not possible to give one colour for the termination of storage life which would be applicable to all varieties, as the results have been inconsistent. The Howell, Josephine, Packham, and Winter Nelis varieties have given the least variable results at 32° F.,

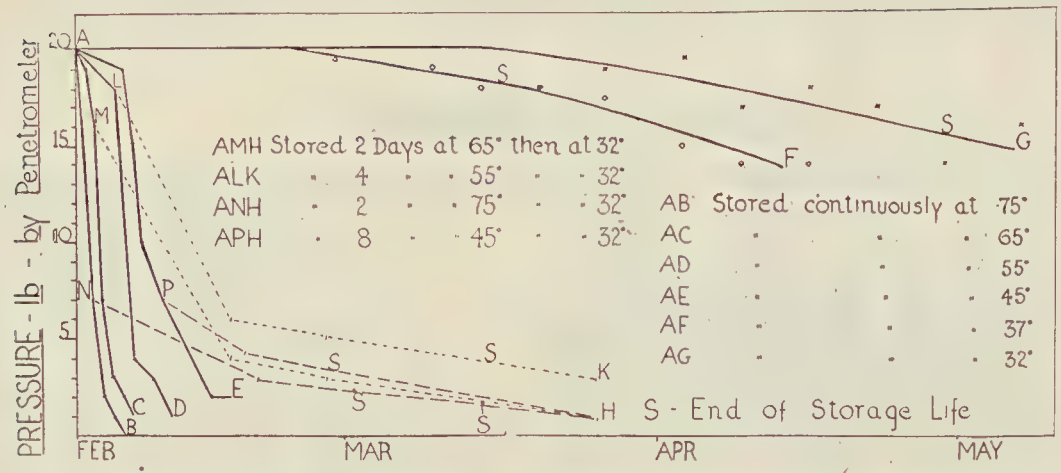

PRESSURE - lb - by Penetrometer
FEB
MAR
APR
MAY
AMH Stored 2 Days at 65° then at 32°
ALK · 4 · · 55° · · 32°
ANH · 2 · · 75° · · 32°
APH · 8 · · 45° · · 32°
AB Stored continuously at 75°
AC · · · 65°
AD · · · 55°
AE · · · 45°
AF · · · 37°
AG · · · 32°
S - End of Storage Life

Fig. 3.—Showing the effect of delayed storage treatments on the subsequent softening of W.B.C. pears at 32° F.

the colour at the termination of storage life being 3–4 for the Howell and Josephine and 2–3 for the Winter Nelis and Packham varieties.

The penetrometer pressure at picking time has been so variable from year to year that it is not possible to state the pressure of each variety at the termination of its storage life. The fall in pressure each year has been reasonably consistent, as is indicated in Table V. The fall in pressure is dependent on the storage temperature (Table V), there being a greater fall at 37° F. than at 32° F. in all except the W.B.C. and Howell varieties. The fall was greatest in the Josephine and Winter Nelis pears at 37° F. as these varieties ripen at this temperature. The fall in pressure is also dependent on the conditions to which the fruit has been subjected between picking and storage. This is indicated by the results in Table VI. and Fig. 3.

It will be seen that the accelerated fall in pressure, which occurred in pears at the higher temperatures prior to storage, was maintained when these pears were transferred to 32° F. The storage life of pears which received delayed storage treatments was terminated at a considerably lower pressure than that of the immediately stored controls.

Pressure measurements, therefore, are of value as a guide to the latest time when pears should be removed from store only in the case of pears stored at 32° F. as soon as possible after picking The average fall in pressure at this temperature in the three pickings of all varieties was four pounds. As the pressure at picking time has varied from year to year, it would be necessary to take the pressure of the pears at picking time, using a sample of ten fruits, and taking the pressure on two sides of the fruit. The average of these twenty readings should give a reliable result. The changes in colour during storage should be closely observed, and as soon as the pear is beginning to lose its green colour a pressure test could be made. If the test should indicate that the pressure has dropped four pounds since

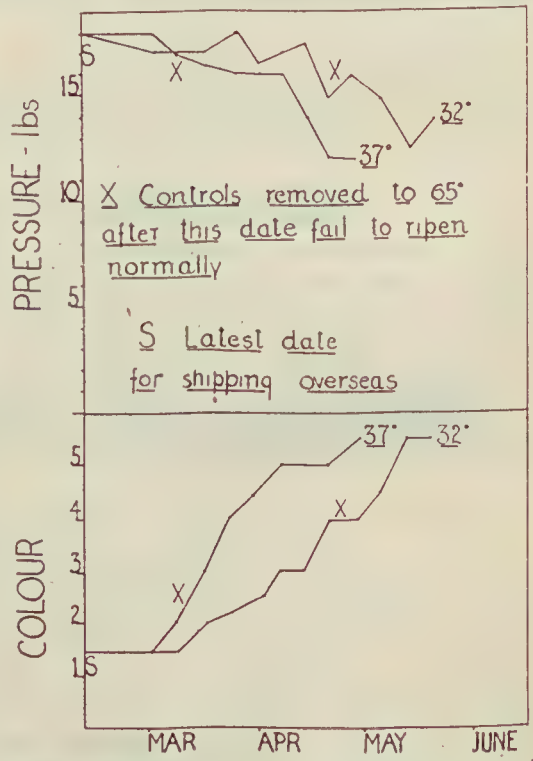
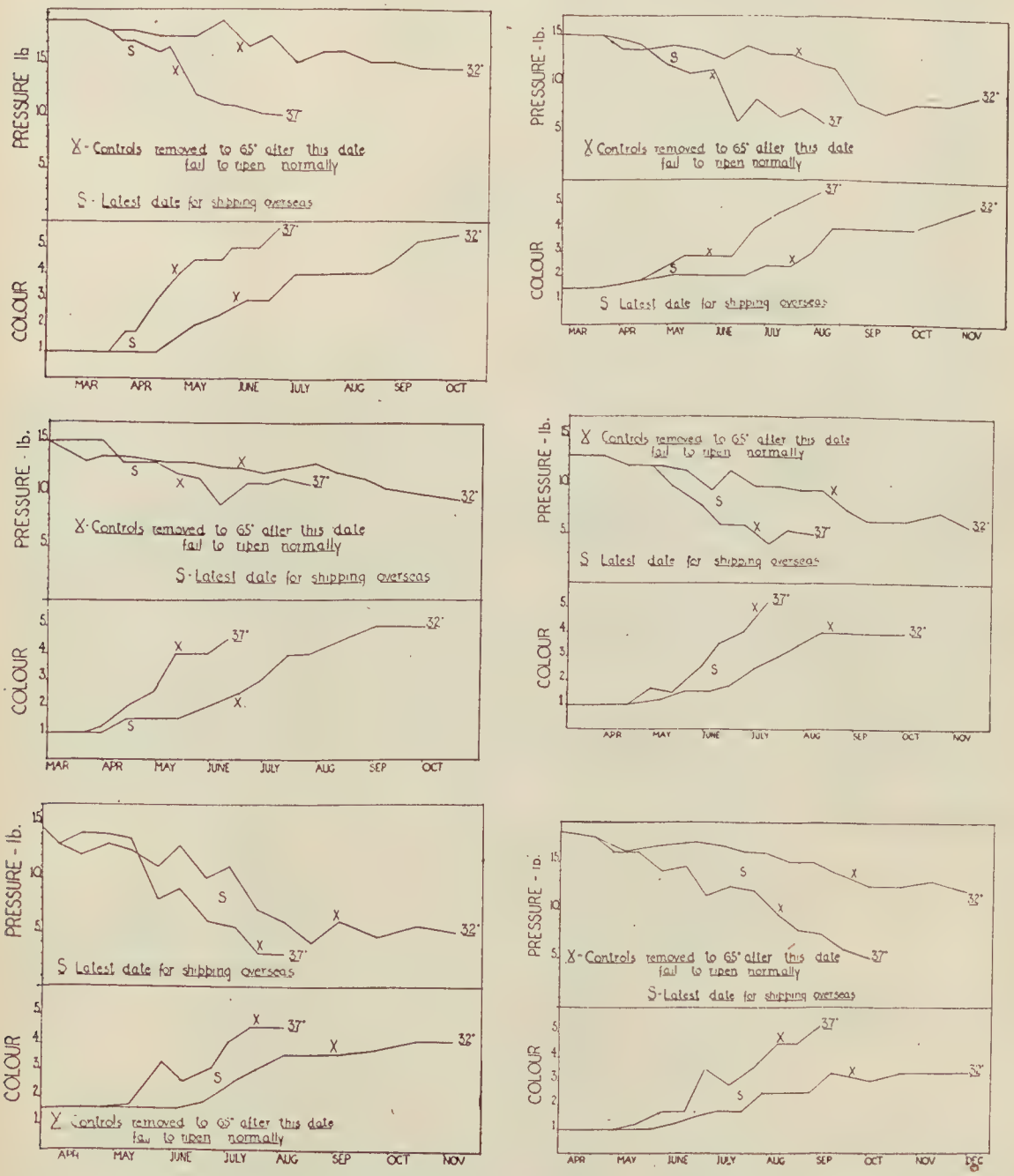


Fig. 4.—Change in penetrometer pressure and colour of W.B.C. pears stored at 32° and 37° F.

picking time, it would be advisable to remove the fruit from store.

The changes in colour and penetrometer pressure during the storage life of the second picking of the W.B.C., Howell, Packham, Bosc, Josephine, Winter Cole and Winter Nelis varieties stored at 32° and 37° F. in 1936 are shown graphically in Figs. 4 to 10.


PRESSURE lb.
COLOUR
X - Controls removed to 65° after this date fail to ripen normally
S - Latest date for shipping overseas
32°
37°
MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

Figs. 5 to 10.—Showing change in penetrometer pressure and colour of different varieties of pears at 32° and 37° F. From left to right—Top: Howell, Packham; Centre: Bosc, Winter Cole; Bottom: Josephine, Winter Nelis.

Changes in Chemical Composition.

In 1933 several cases of W.B.C. pears picked at Doncaster were stored at 34° F., and samples of ten pears were analysed during subsequent storage until the final development of scald. Estimations of sugar and acid were made as previously described. Acetaldehyde and alcohol were estimated by steam distillation of about 150 grams of flesh. In one half of the distillate, acetaldehyde was estimated by a modified Ripper method (12), and in the other half, alcohol was determined by the method of Thomas (11). It has been shown that during maturation on the tree there is an increase in cane sugar. This increase apparently continues during ripening off the tree, but is inhibited at low temperatures, for at 34° F. there was no significant change either in cane or reducing sugar (Fig. 11).

Acid was lost steadily during storage at the rate of approximately 0.0045 per cent. per week. (Fig. 12).

Further estimations of the sugar and acid content of pears stored at 32° and 37° F. were made in 1935, and the results are recorded in Table VII. The sampling variation was unfortunately much greater in this year than in 1933, but a fall in acid content is again indicated. There was no significant change in the sugar content.

The changes in alcohol and acetaldehyde during storage are indicated in Table VII. and in Figs. 13 and 14. Gerhardt and Ezell (3) have shown that towards the end of the storage life of Comice pears, there is a decided increase in both acetaldehyde and alcohol, and the results shown here indicate the same increase in W.B.C. pears. At the termination of storage life, the alcohol content was 0.01 per cent. and acetaldehyde 0.001 per cent. As a guide to the termination of storage life, the use of alcohol and acetaldehyde determinations is rather limited, as there was no appreciable increase in these constituents until the storage life had terminated. The alcohol content of pears which scalded in store was 0.1 per cent.

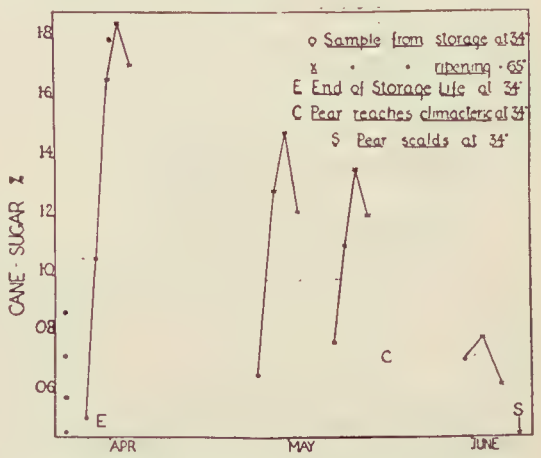


Fig. 11.—Showing changes in cane-sugar content of Williams pears during storage and ripening.

Table VII.—Chemical Changes during the Cool Storage of W.B.C. Pears from Doncaster.

Date of Picking.	Storage Temperature.	Storage Period.	Reducing Sugar	Cane Sugar.	Total Sugar.	Acid.	Acetaldehyde.	Alcohol.
			%	%	%	%	%	%
20th February, 1933 ..	34° F.	2 days	7·36	0·58	7·94	0·178	0·0004	0·006
	34° F.	2 days	7·92	0·72	8·64	0·184	..	..
	34° F.	2 days	7·67	0·87	8·54	0·178	..	..
	34° F.	2 days	7·32	0·46	7·78	0·178	..	..
	34° F.	2 days	7·32	0·46	7·78	0·178	..	..
	34° F.	35 days	8·12	0·52	8·64	0·163	0·0007	0·006
	34° F.	64 days	8·47	0·67	9·14	0·145	0·0014	0·012
	34° F.	77 days	7·8	0·78	8·58	0·129	0·001	0·013
	34° F.	99 days	7·92	0·72	8·64	0·117	0·0033	0·074
4th February, 1935 ..	32° F.	2 days	6·56	1·14	7·7	0·154	..	..
	32° F.	42 days	7·46	0·65	8·11	0·119	..	..
	32° F.	71 days	6·69	1·1	7·79	0·128	..	..
	32° F.	82 days	7·33	0·31	7·64	0·109	..	..
	32° F.	95 days	7·33	1·22	8·55	0·11	..	..
	32° F.	117 days	7·49	0·65	8·14	0·126	..	..
4th February, 1935 ..	37° F.	21 days	7·39	0·65	8·04	0·135	..	..
	37° F.	32 days	7·61	1·13	8·74	0·12	..	..
	37° F.	42 days	7·33	1·09	8·42	0·12	..	..
	37° F.	52 days	6·81	0·86	7·67	0·12	..	..

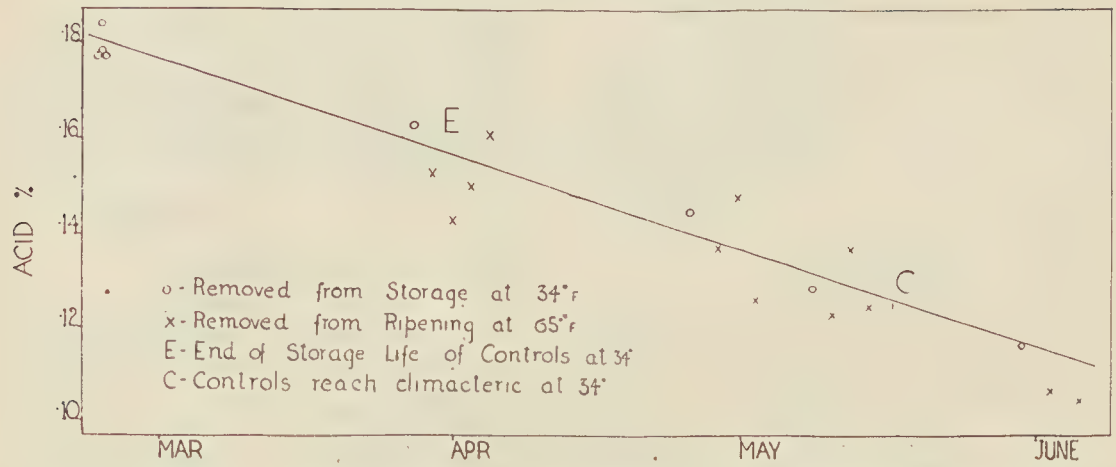


Fig. 12.—Showing changes in acid content of Williams pears during storage and ripening.

Changes in Respiration.

From the time of picking until scald develops in store, the pear is taking in oxygen and liberating carbon dioxide, a process called respiration. The amount of carbon dioxide liberated is dependent on the variety of the fruit and the temperature at which the fruit is stored. The amount of carbon dioxide liberated by most of the varieties of pears was collected at several temperatures and measured. This was done by placing the fruit in an air-tight glass container and passing over it a stream of air which picked up the carbon dioxide respired by the fruit. The air stream was then drawn over a solution of barium hydroxide which absorbs carbon dioxide. The fruit was kept in an insulated cabinet, the temperature of which was controlled by a toluene mercury thermostat to within $\pm 0{\cdot}2°$ F. The daily rate of the carbon dioxide liberated by the different varieties is plotted against time in Figs. 15 to 23.

It will be observed that the rate of carbon dioxide production increased up to a certain point and then diminished. The point of maximum respiration is termed the climacteric. It will be observed in Figs. 15 and 16 that, when the climacteric was passed, the respiratory activity fell very rapidly until it eventually reached a point where no carbon dioxide was liberated. This marks the death of the pear, the fruit being discoloured in the flesh and skin and having a disagreeable odour and taste.

It will be observed in the Winter Nelis pears, at 32° and 37° F. (Figs. 22 and 23) that the rate fell slightly after the climacteric but then remained constant. The difference between this curve and those in Figs. 15 and 16, is probably due to the fact that ripening has taken place in the Winter Nelis pear. The difference between

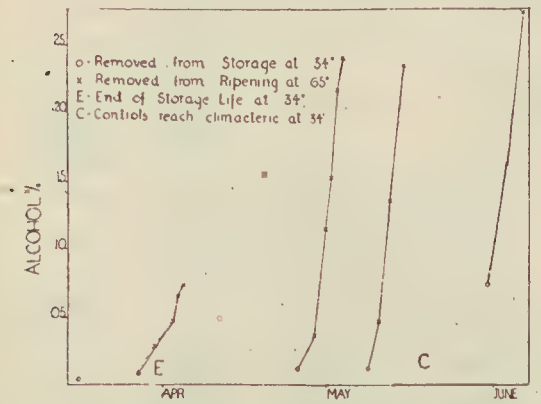


Fig. 13.—Change in alcohol content of Williams pears during storage and ripening.

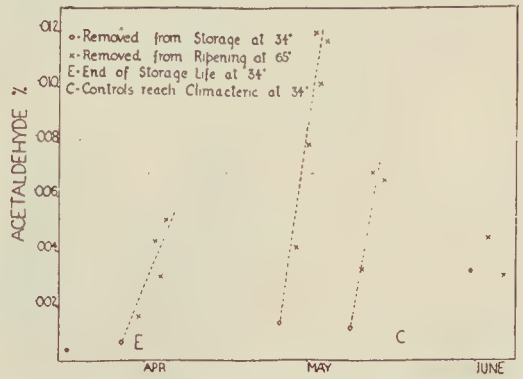


Fig. 14.—Showing change in acetaldehyde content of Williams pears.

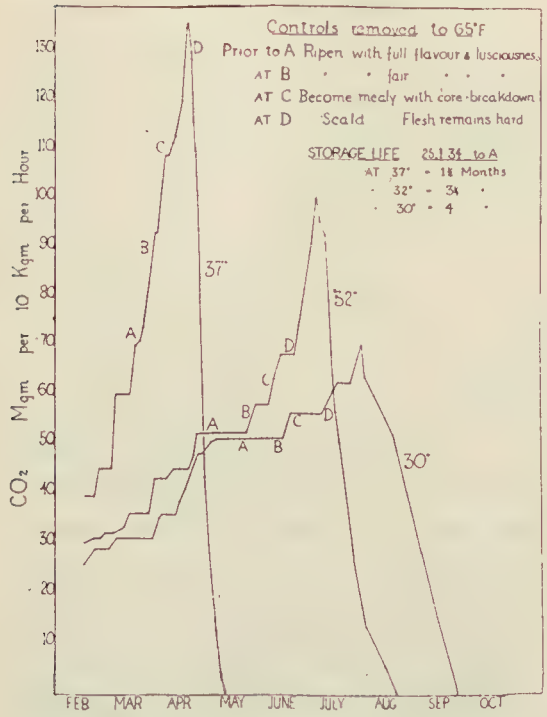

Controls removed to 65°F
Prior to A Ripen with full flavour & lusciousness
AT B " " fair " " "
AT C Become mealy with core-breakdown
AT D Scald Flesh remains hard
STORAGE LIFE 25.1.34 to A
AT 37° = 1½ Months
" 32° = 3½ "
" 30° = 4 "
CO2 Mgm per 10 Kgm per Hour
37°
32°
30°
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Fig. 15.—Showing the respiration of W.B.C. pears at 30°, 32° and 37° F. (Picked at Doncaster 25.1.34).

the ripening and non-ripening curves is also clearly indicated by the results obtained with W.B.C. pears removed at various times from 37° F. to 65° F. expressed graphically in Fig. 24.

Exactly comparable fruits were held at the same temperatures as the respiration lots, and samples were removed at weekly intervals to a ripening temperature of 65° F. The stages in the life of the pear, where the various changes occur on removal, are clearly marked in Figs. 15 to 24. The length of storage life is the time from the beginning of storage till the last removal

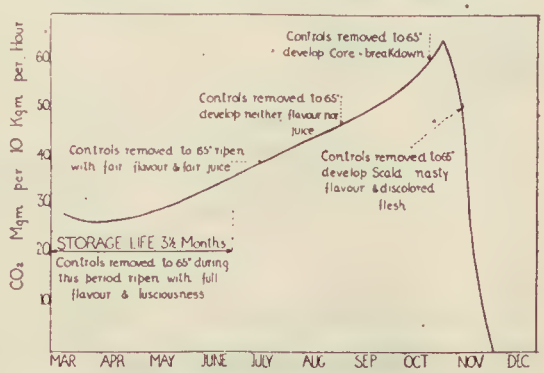
Controls removed to 65° develop Core-breakdown
Controls removed to 65° develop neither flavour nor juice
Controls removed to 65° ripen with fair flavour & fair juice
Controls removed to 65° develop Scald nasty flavour & discolored flesh
STORAGE LIFE 3½ Months
Controls removed to 65° during this period ripen with full flavour & lusciousness
CO2 Mgm per 10 Kgm per Hour
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Fig. 16.—Rate of respiration—Bosc pears at 32° F. (Picked 2.3.36).

when normal ripening occurred. In all varieties, except the Winter Nelis, the storage life terminated a considerable time before the climacteric was reached, and the climacteric occurred some time before disorders actually developed in the fruit in store. The Winter Nelis pears were fully ripe at 37° F. and partially ripe at 32° F., and in consequence they could be kept in store for a relatively longer period as they merely had to hold their condition for a marketable period after removal. The relation between length of storage life and time to reach the climacteric and time to develop scald or mould in store is recorded in Table VIII. Scald developed in all

TABLE VIII.—The Relation between Length of Life, Time to Reach the Climacteric and Time to Develop Scald or Mould in Store.

Variety.	Temperature.	Length of Storage Life.	Time to Reach the Climacteric. (Days).	Time to Develop Mould or Scald.	Length of Storage Life. Time to Reach Climacteric.	Length of Storage Life. Time to Develop Mould or Scald.
W.B.C.	30° F.	105 days	180	260 days, Scald	0·6	0·4
	32° F.	84 days	140	200 days, Scald	0·6	0·4
	37° F.	42 days	70	105 days, Scald	0·6	0·4
	45° F.	12 days	18	30 days, Scald	0·6	0·4
Howell	32° F.	119 days	215	300 days, Scald	0·5	0·4
	37° F.	77 days	123	210 days, Scald	0·6	0·4
Bosc	32° F.	119 days	236	262 days, Scald	0·5	0·5
	37° F.	77 days	126	151 days, Scald	0·6	0·5
Packham	32° F.	147 days	194	330 days, Scald	0·7	0·4
	37° F.	98 days	129	240 days, Scald	0·7	0·4
Winter Nelis	32° F.	182 days	188	240 days, Mould	1·0	0·7
	37° F.	119 days	122	165 days, Mould	1·0	0·7

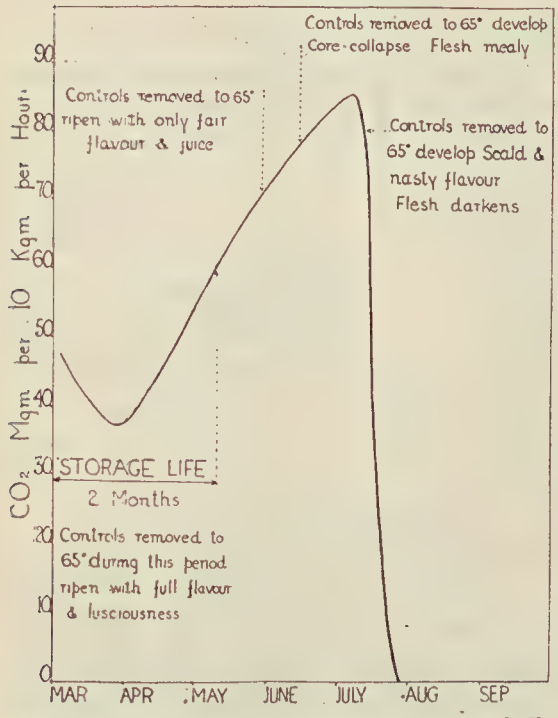
Controls removed to 65° develop Core-collapse Flesh mealy
Controls removed to 65° ripen with only fair flavour & juice
Controls removed to 65° develop Scald & nasty flavour Flesh darkens
STORAGE LIFE
2 Months
Controls removed to 65° during this period ripen with full flavour & lusciousness
CO_2 Mgm. per 10 Kgm per Hour
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Fig 17.—Respiration of Bosc pears at 37° F. (Picked 2.3.36).

the varieties except the Winter Nelis, which ripened at the low temperatures and developed mould in the overripe stage.

The length of storage life of all varieties except the Winter Nelis was approximately three-fifths of the time to reach the climacteric and two-fifths

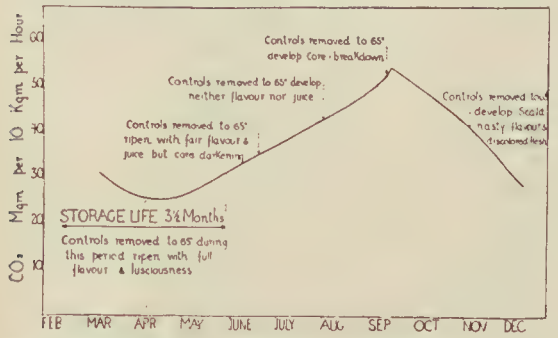
Controls removed to 65° develop Core-breakdown
Controls removed to 65° develop neither flavour nor juice
Controls removed to 65° ripen with fair flavour & juice but core darkening
Controls removed to develop Scald nasty flavour & discoloured flesh
STORAGE LIFE 3½ Months
Controls removed to 65° during this period ripen with full flavour & lusciousness
CO_2 Mgm. per 10 Kgm. per Hour
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Fig. 18.—Rate of respiration—Howell pears at 32° F. (Picked 11.2.36).

of the time to reach scald. This shows how relatively short is the "commercial" storage life of the pear compared to its actual length of life in store. There is no method of determining when the climacteric occurs, other than by continuous measurements of carbon dioxide output. Its occurrence in ripening fruits is associated with the maximum development of colour and flavour, but this does not apply to non-ripening fruits. At the time of the climacteric, all varieties had developed full colour and the pressure had fallen five pounds except in the Winter Nelis pears at 37° F., where the fall was ten pounds.

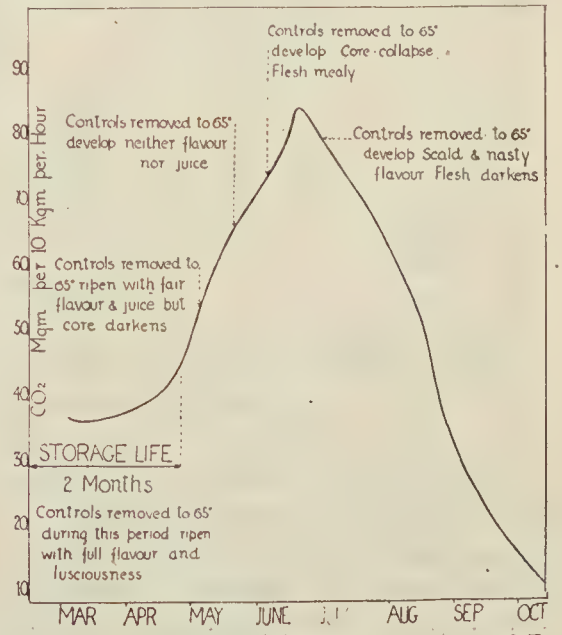

Controls removed to 65° develop Core-collapse Flesh mealy
Controls removed to 65° develop neither flavour nor juice
Controls removed to 65° develop Scald & nasty flavour Flesh darkens
Controls removed to 65° ripen with fair flavour & juice but core darkens
STORAGE LIFE
2 Months
Controls removed to 65° during this period ripen with full flavour and lusciousness
CO_2 Mgm. per 10 Kgm per Hour
MAR APR MAY JUNE AUG SEP OCT

Fig. 19.—Respiration of Howell pears at 37° F. (Picked 11.2.36).

Effect of Maturity and Size.

The respiratory activity of various sizes of three maturities of W.B.C. pears from both Doncaster and Shepparton was determined at 32° and 37° F. and the results are recorded in Table IX.

The results indicate that the initial rate of respiration was not influenced to any extent by either size or maturity. Although the values at

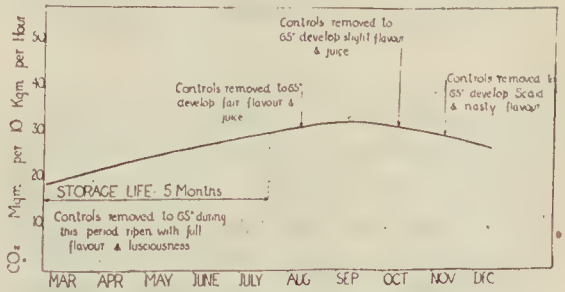

Controls removed to 65° develop slight flavour & juice
Controls removed to 65° develop fair flavour & juice
Controls removed to 65° develop Scald & nasty flavour
STORAGE LIFE 5 Months
Controls removed to 65° during this period ripen with full flavour & lusciousness
CO_2 Mgm. per 10 Kgm per Hour
MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

Fig 20.—Rate of respiration—Packham pears at 32° F. (Picked 24.2.36).

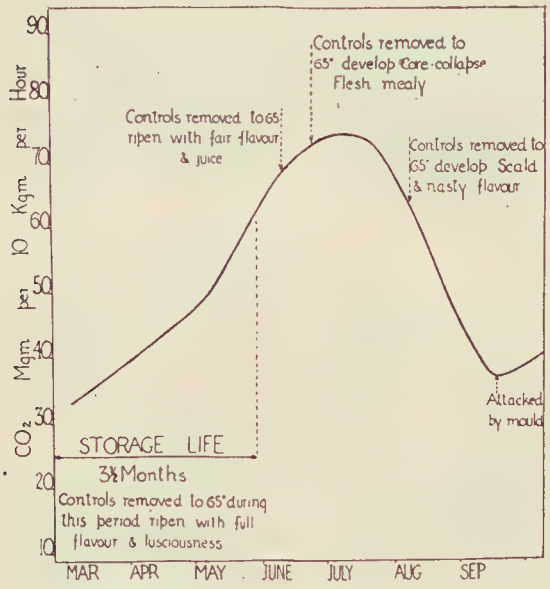

Controls removed to 65° develop Core-collapse Flesh mealy
Controls removed to 65° ripen with fair flavour & juice
Controls removed to 65° develop Scald & nasty flavour
Attacked by mould
STORAGE LIFE
3½ Months
Controls removed to 65° during this period ripen with full flavour & lusciousness
CO2 Mgm. per 10 Kgm. per Hour
MAR APR MAY JUNE JULY AUG SEP

Fig. 21.—Rate of respiration—Packham pears at 37° F. (Picked 24.2.36).

the climacteric were variable, the variation cannot be attributed to size or maturity. The time at which the climacteric occurred at 37° F. was not influenced by size or maturity. At 32° F., however, the climacteric occurred ten days earlier in the largest sized fruit and 22 days earlier in the most mature fruit of the same size.

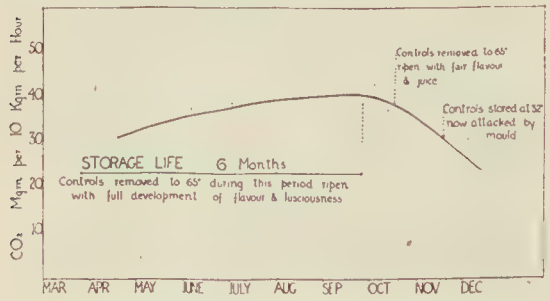

Controls removed to 65° ripen with fair flavour & juice
Controls stored at 32° now attacked by mould
STORAGE LIFE 6 Months
Controls removed to 65° during this period ripen with full development of flavour & lusciousness
CO2 Mgm. per 10 Kgm. per Hour
MAR APR MAY JUNE JULY AUG SEP OCT NOV DEC

Fig. 22.—Respiration of Winter Nelis pears at 32° F. (Picked Doncaster 23.3.36).

The storage life of the most mature fruit, however was only one week less at 32° F. than that of the least mature, so that a difference of 22 days in the time to reach the climacteric was equivalent to a difference of only one week in the storage life. On this basis the difference in storage life between the two sizes would be approximately. three days, and this is of no practical importance. It is interesting to note that in all cases the relation between the length of storage life and the time to reach the climacteric was 0·7 and the time to reach death, 0·5.

The results for two pickings of the same size, at 32° F., are plotted in Fig. 25.

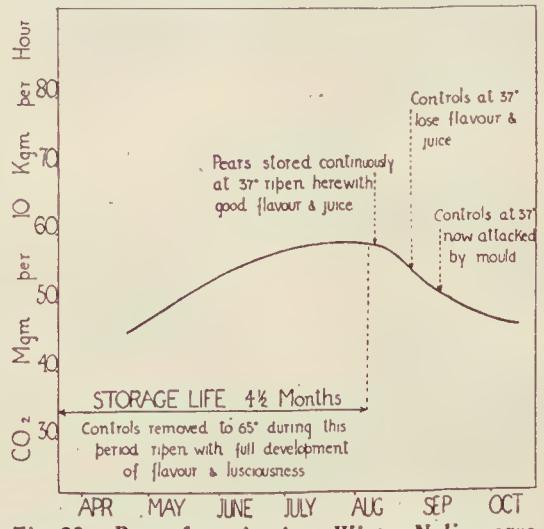

Controls at 37° lose flavour & juice
Pears stored continuously at 37° ripen herewith good flavour & juice
Controls at 37° now attacked by mould
STORAGE LIFE 4½ Months
Controls removed to 65° during this period ripen with full development of flavour & lusciousness
CO2 Mgm. per 10 Kgm. per Hour
APR MAY JUNE JULY AUG SEP OCT

Fig. 23.—Rate of respiration—Winter Nelis pears at 37° F. (Picked 23.3.36).

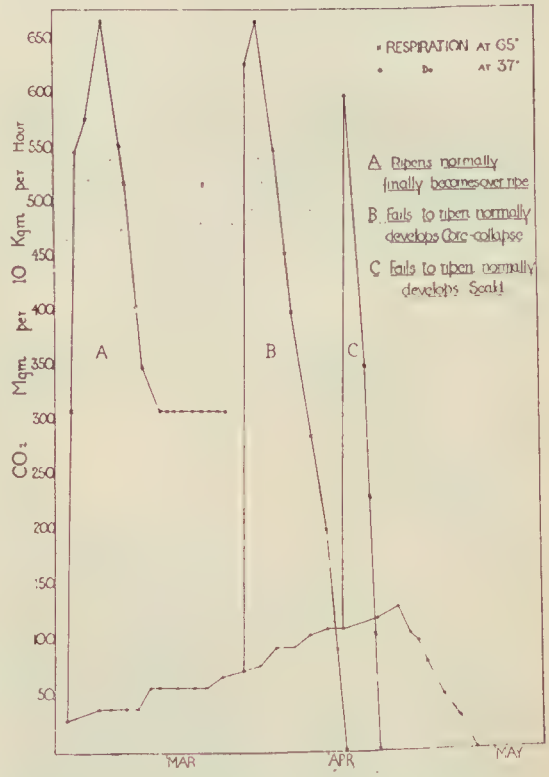

RESPIRATION AT 65°
" " AT 37°
A Ripens normally finally becomes over ripe
B Fails to ripen normally develops Core-collapse
C Fails to ripen normally develops Scald
A
B
C
CO2 Mgm. per 10 Kgm. per Hour
MAR APR MAY

Fig. 24.—The respiration of W.B.C. pears at 65° F after various periods at 37° F.

TABLE IX.—The Effect of Maturity and Size on Respiration.

District.	Date of Picking.	Size of Fruit.	Storage Temperature.	Initial Value of Respiration in mgs. per 10 K.H.	Value of Respiration at Climacteric in mgs. per 10 K.H.	Date of Climacteric.	Number of Days from Time of Picking Till Climacteric.	Number of Days from Time of Picking Till Death.	Length of Storage Life in Days.	Length of Storage Life.	
										Time to Reach Climacteric.	Time to Reach Death.
		Inches.	° F.				Days.	Days.	Days.		
Doncaster ..	25.1.34	2¼	37	34	143	3.4.34	68	93	49	0·7	0·5
	25.1.34	2½	37	35	136	7.4.34	72	97	49	0·7	0·5
	25.1.34	2¾	37	33	139	7.4.34	72	97	49	0·7	0·5
	31.1.34	2¼	37	37	162	9.4.34	68	87	42	0·6	0·5
	31.1.34	2½	37	34	131	2.4.34	61	87	42	0·7	0·5
	31.1.34	2¾	37	38	133	5.4.34	64	86	42	0·7	0·5
	7.2.34	2¼	37	37	151	2.4.34	54	72	35	0·7	0·5
	7.2.34	2½	37	42	141	5.4.34	54	72	35	0·6	0·5
	7.2.34	2¾	37	37	122	1.4.34	53	72	35	0·7	0·5
	25.1.34	2¼	32	24	82	30.6.34	156	202	98	0·6	0·5
	25.1.34	2¾	32	24	82	21.6.34	147	202	98	0·7	0·5
	7.2.34	2¼	32	26	82	8.6.34	121	155	77	0·6	0·5
	7.2.34	2¾	32	26	65	28.5.34	110	143	77	0·7	0·5
Shepparton	24.1.34	2¼	37	33	126	17.4.34	83	111	56	0·7	0·5
	24.1.34	2½	37	33	138	12.4.34	78	111	56	0·7	0·5
	24.1.34	2¾	37	33	125	11.4.34	77	111	56	0·7	0·5

The Relation Between Temperature, Respiration and Length of Storage Life.

Kidd and West (8) have found with apples, that a rise in temperature has the same effect in increasing the maximum and minimum values of respiration as in reducing the duration of life, and that the same amount of carbon dioxide is liberated at each temperature, from the time of gathering until the termination of storage life by fungal attack. From the respiration and storage results, the various relationships have been evaluated and are recorded in Table X.

It will be observed that the minimum and maximum values of respiration of the W.B.C. pears were increased 1·5 times over the range, 30° to 55° F., compared with 1·1 times over the range 55° to 65° F., for a rise in temperature of 5° F. It will be shown later, that ripening in this variety occurs only above 55° F., and this may be responsible for the retardation in

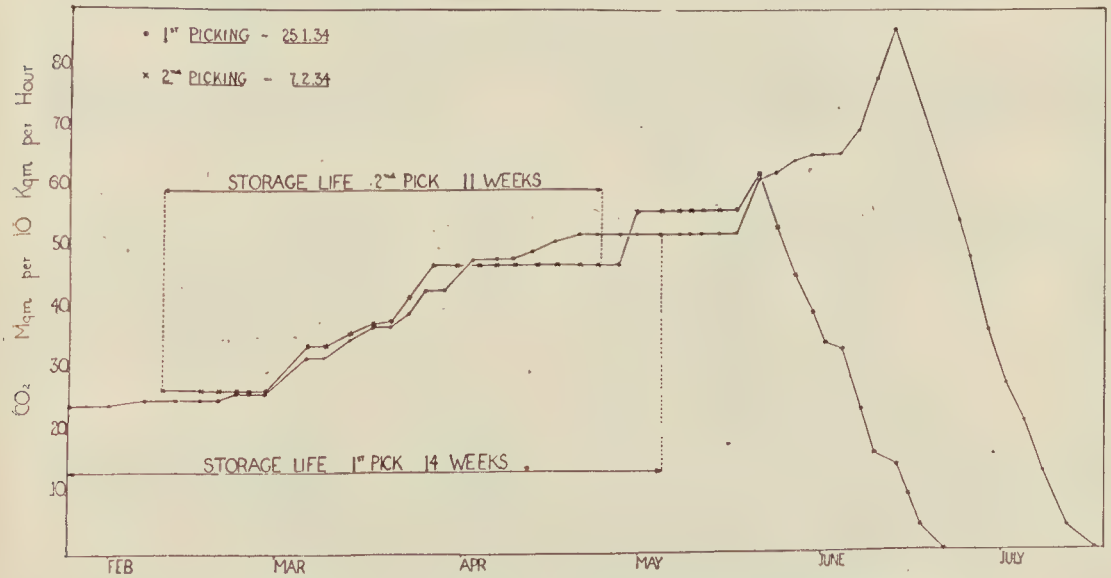


Fig. 25.—Showing the respiration at 32° F. of two pickings of W.B.C. pears.

respiration. The maximum and minimum values of respiration of the other varieties were increased by the same amount as the W.B.C. over the range 30° to 55° F., and the storage life of all varieties except the W.B.C. was decreased to the same extent. The same amount of carbon dioxide was liberated at each temperature during the storage life of the Howell, Bosc, Packham, and Winter Nelis varieties, and until the death of the Bosc variety—this was the only one of the later-keeping varieties which had ceased respiring at 32° and 37° F., when the respiration experiments were terminated.

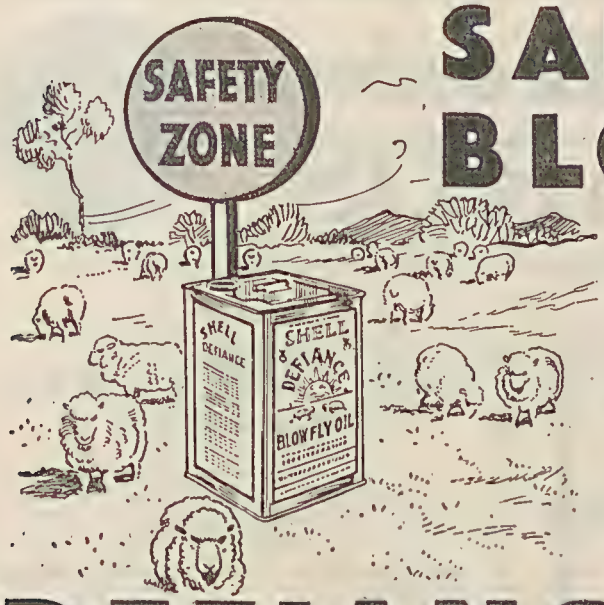
Different amounts of carbon dioxide were liberated at each temperature during the storage life and until the death of the W.B.C. pear, and the length of storage life was related to the average and not to the minimum or maximum value of respiration. The length of time W.B.C. pears could be kept at non-ripening temperatures and still ripened normally on removal, was reduced by 50 per cent. for a rise in temperature of 5° F. The time to ripen, however, was reduced by only 20 per cent. for the same rise in temperature. It is worthy of note that Kidd and West found that the storage life of apples was reduced 1·5 times for a rise in temperature of 10° F., i.e., half the amount by which the varieties of pears other than the W.B.C. are reduced for the same rise in temperature.

TABLE X.—The Relation Between Temperature, Respiration, and Length of Storage Life.

Variety.	Temperature.	Minimum Value of Respiration (mgs. per 10 KH.).	Number of Times Minimum Respiration Increased for a Rise of 5° F.	Maximum Value of Respiration (mgs. per 10 KH.).	Number of Times Maximum Respiration Increased for a Rise of 5° F.	Length of Storage Life, in Days.	Number of Times Length of Storage Life Reduced for a Rise of 5° F.	Amount of CO_2 Respired during storage life (mgs. per 10 KH.).	Number of days till death.	Amount of CO_2 respired from Time of Picking Till Death (mgs. per 10 KH.).	Average Value of Respiration from Time of Picking Till Death (mgs. per 10 KH.).	Number of Times Average Respiration Increased for a Rise of 5° F.
	° F.											
W.B.C. ..	30	25	1·6 over the range, 30°–55° F.	70	1·64 over the range, 30°–45° F.	105	2·0 over the range, 30°–45° F.	3836	260	8580	33	2·0
	32	30		85		84		3400	200	8160	41	
	37	45		140		42		2352	87	6092	70	
	45	85		300		12		1900	30	5254	175	
	55	230	1·1 over the range, 55°–65° F.	No records	1·2 over the range, 45°–65° F.	10*	1·25 over the range, 55°–75° F.					
	60	No records		No records		8*						
	65	300		680		6*						
	70	No records	..	No records	..	5*						
	75	No records	..	No records	..	4*						
Howell ..	32	25	1·5	54	1·57	119	1·54	3101	..	..	..	..
	37	38		85		77		3210	..	..	..	..
Bosc ..	32	27	1·5	42	1·57	119	1·54	3920	262	10105	39	1·6
	37	41		65		77		3823	151	9614	64	
Packham ..	32	21	1–5	38	1·57	147	1·5	3840	..	..	..	..
	37	32		60		98		3946	..	..	..	..
Winter Nelis	32	30	1·5	40	1·55	182	1·53	8152	..	..	..	..
	37	45		62		119		8224	..	..	..	..

* Days to ripen.

(This paper will be concluded in a subsequent issue.)



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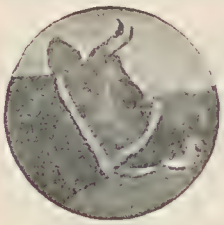
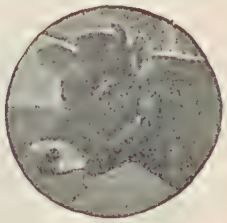


Stud Breeders' CARDS



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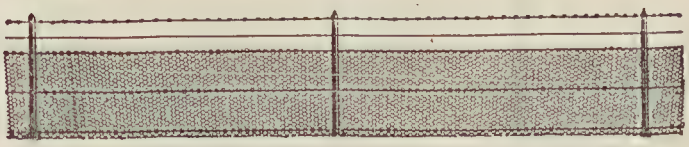

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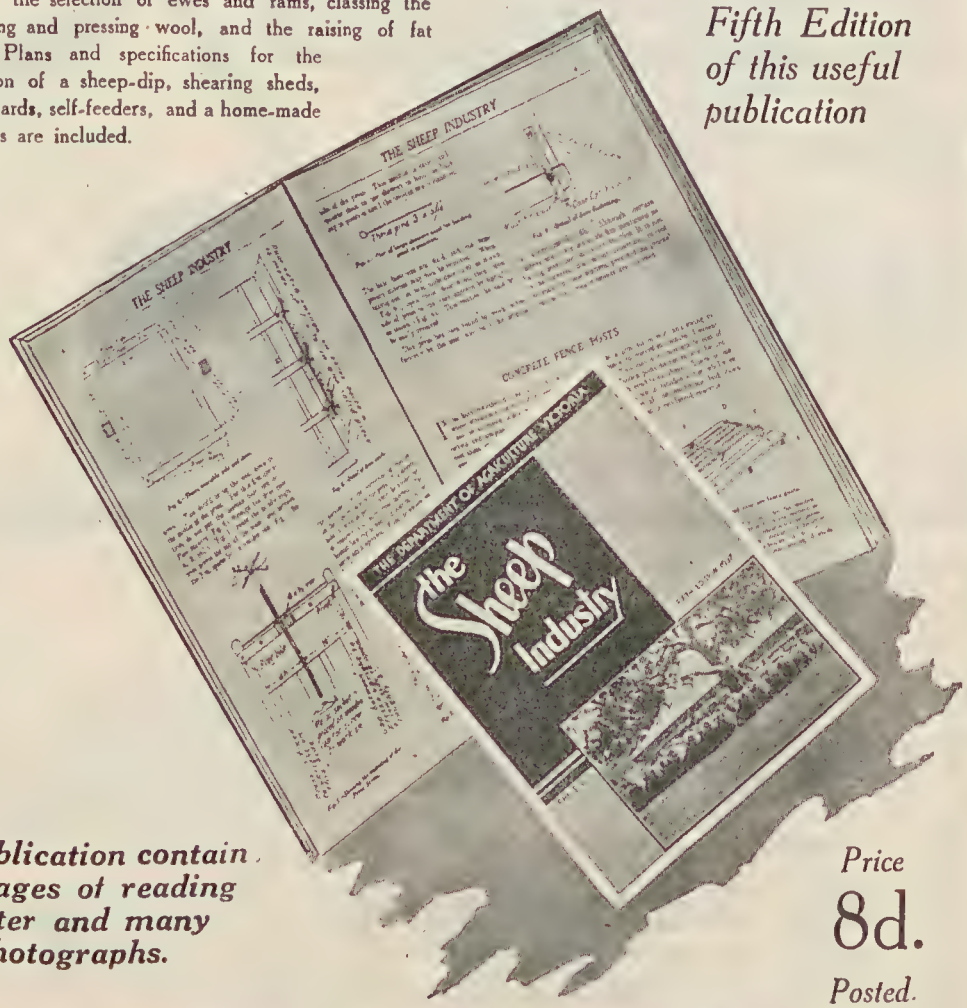

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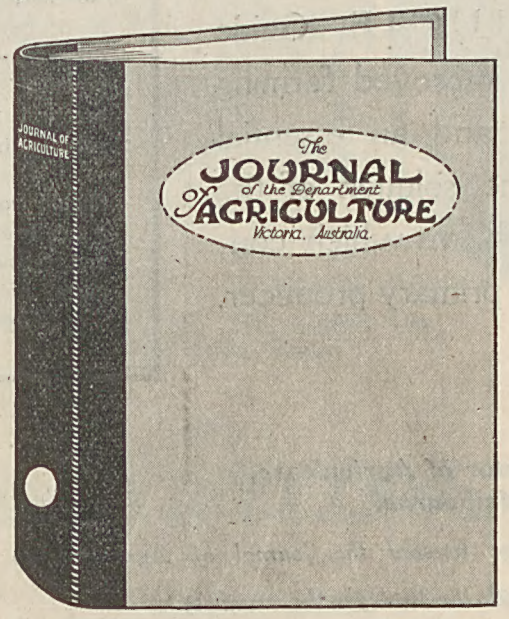

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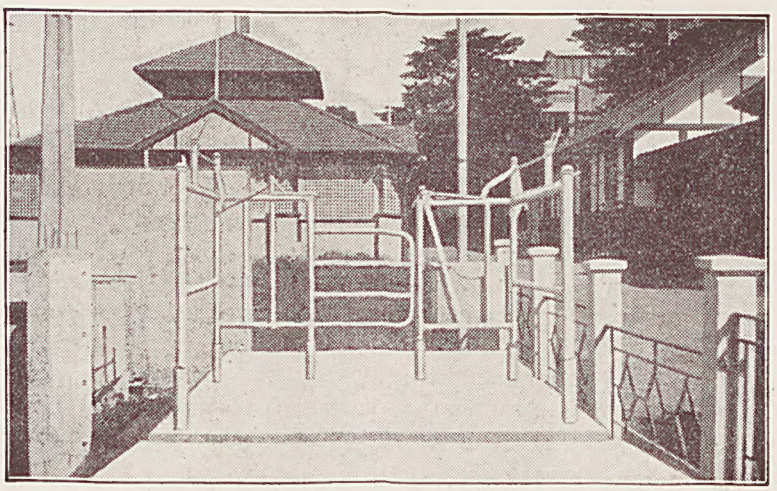

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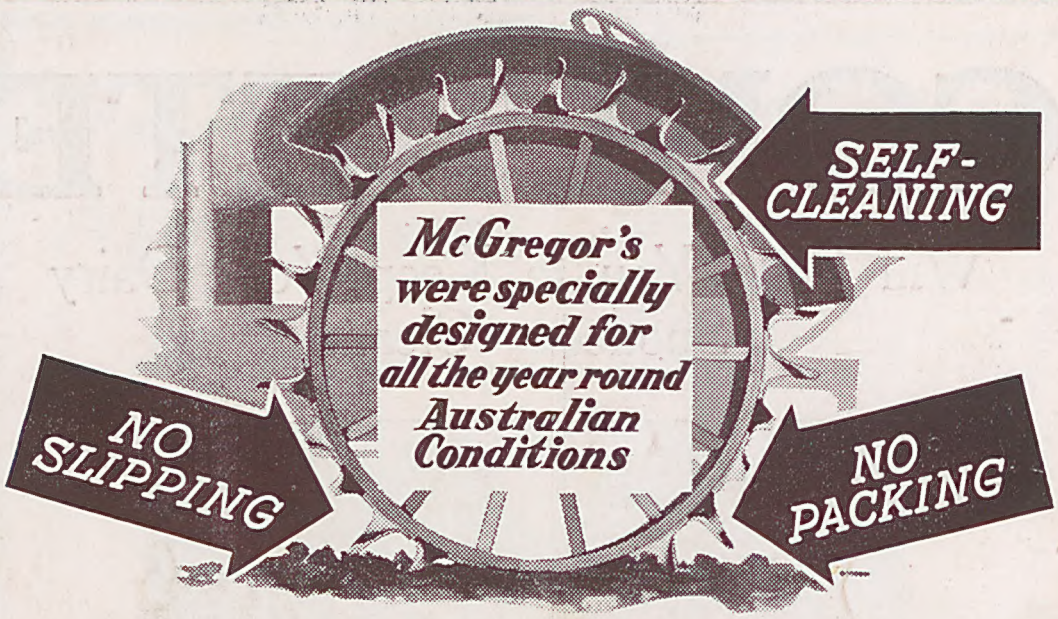

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